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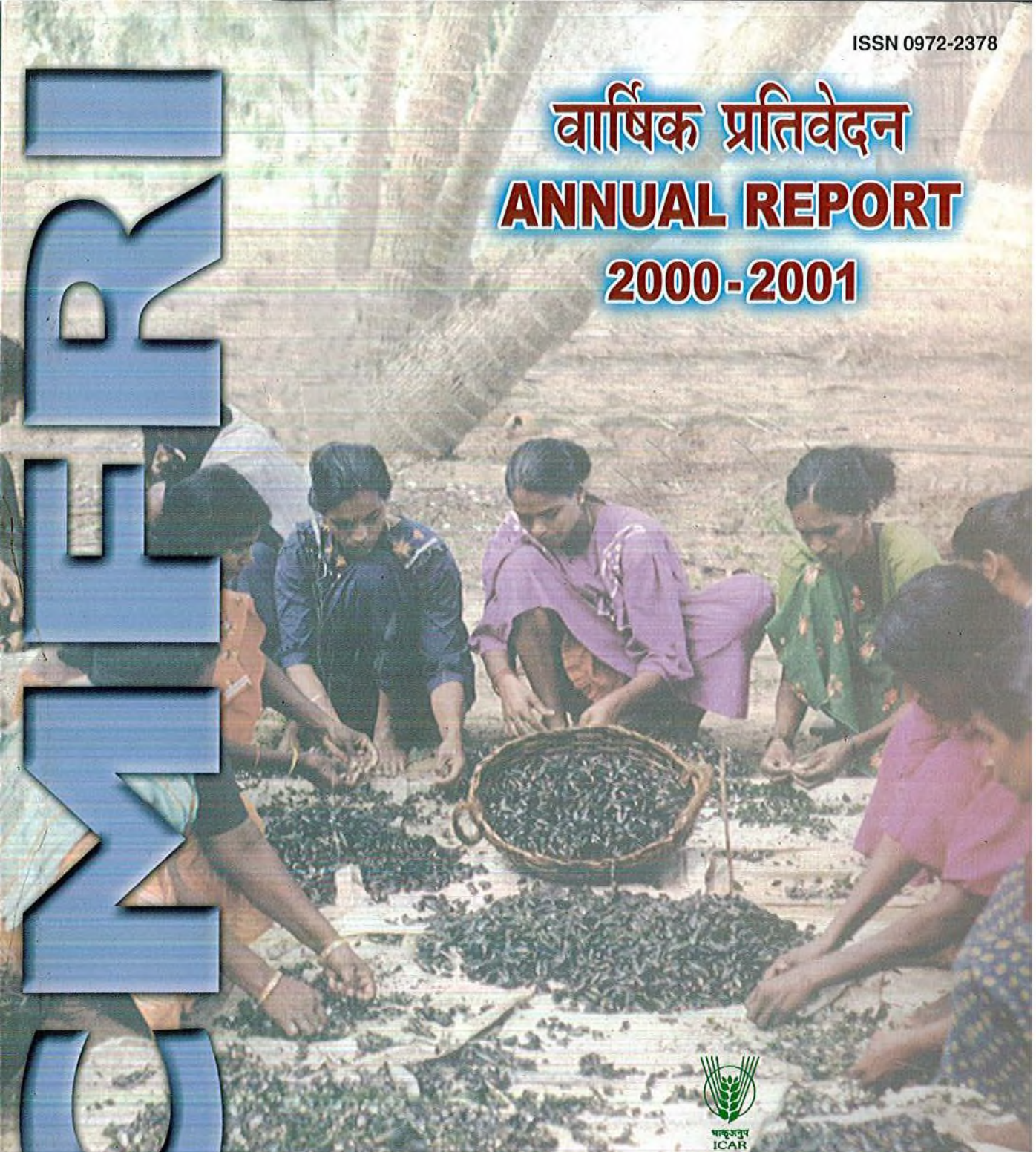
CMFRI

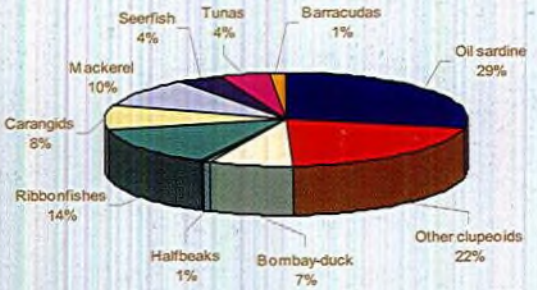
वार्षिक प्रतिवेदन
ANNUAL REPORT
2000-2001



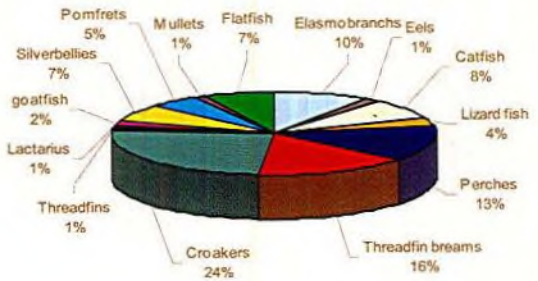
CENTRAL MARINE FISHERIES RESEARCH INSTITUTE
Indian Council of Agricultural Research
Post Box No. 1603, Tatapuram P. O.
Ernakulam, Cochin - 682 014, India

Components of Marine finfish landings during 2000

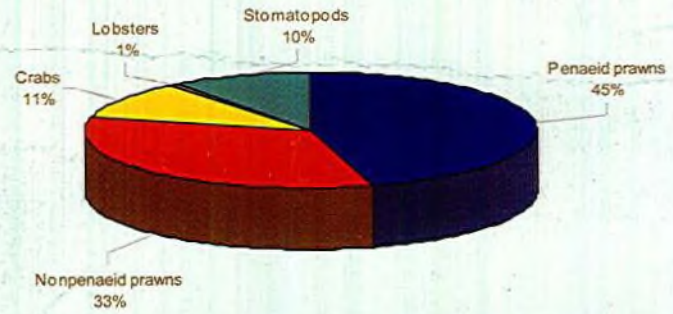
Components of pelagic finfish landings



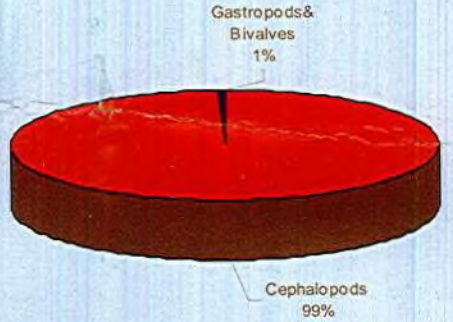
Components of demersal finfish landings



Components of crustacean landings



Components of molluscan landings



Annual Report
2000-2001

भाकृअनुप
ICAR

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE
Indian Council of Agricultural Research
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PREFACE

Fisheries, particularly Marine Fisheries are receiving increased attention due not only to their importance in meeting the protein food requirements of the people but also due to their importance in national economy, employment generation and export trade. Such a situation naturally calls for increased attention of the Governments, Scientists, administrators, fishing industry and fisherfolk. Besides, this also offers challenges in the R&D efforts: on the one hand, there is need to find ways of increasing production from capture while intensifying efforts at optimizing the yields of the stocks that are exploited at near optimal levels and, development, improvement and transfer of technologies for production through culture on the other. There is also need to have emphasis on the livelihoods of the communities solely dependent on fisheries.

The Central Marine Fisheries Research Institute (CMFRI) in its own way has attempted to offer research support in the cause of marine fisheries and mariculture development in the country during this year also through its in-house research projects, sponsored *ad hoc* research programmes and consultancy and contract services. Data on marine fish production from all along the Indian coastline and the characteristics of all major exploited finfish and shell fish stocks were generated, processed and the results brought out. The characteristics of the marine fisheries environment were studied. Efforts at developing and improving the mariculture technologies were continued with increased thrust on transferring them to the end users.

An important initiative during the year is the organization of Brainstorming Sessions on researchable issues in marine fisheries and mariculture at the Research Centres as well as Headquarters. This has helped in understanding the various issues in proper perspective. The linkages with International Institutions like the ICLARM have been strengthened and fresh linkages with Australian Centre for International Agricultural Research (ACIAR), Department for International Development (DFID), United Kingdom and Sharjah Airport International Free Zone Authority, UAE are being established.

The Institute participated in deliberations and formulation of recommendations in two major committees constituted by the Government of India: Committee on Revalidation of the Potential Yield of Marine Fisheries Resources in the Indian EEZ and the Committee on Comprehensive Marine Fisheries Policy. For the first time, with the help of the data generated at the Institute, the potential yield estimates of over 60 species of exploited finfish and shellfish and certain sustenance fishery resources like gastropods and bivalves were made. With the expertise available, the Institute has also contributed to the formulation of draft X Plan proposals in marine fisheries for the Government of India. Besides, the Institute has also assisted in formulating the X Plan proposals of the Department of Ocean Development, Government of India.

In the area of Human Resources Development, a large number of training programmes were offered through the KVK and TTC. The education programmes (M.F.Sc., Ph.D.) continued as in the past.

During the year, the Institute succeeded in procuring certain important equipments for carrying out advanced research in frontier areas like biotechnology, genetics and immunology, while upgrading the existing facilities particularly in the area of Information Technology.The efforts in attracting funds for research were continued. Ten *ad hoc* projects at a cost of Rs 91 lakhs were sanctioned and an amount of Rs 34,17,000 for nine Consultancy and contract research programmes. Under the NATP, eight major projects at a cost of Rs 500 lakhs were also sanctioned to the Institute.

The brief report presented here reveals that the targets fixed for the year were achieved adequately in spite of certain constraints on manpower and budget. All the staff of the Institute have contributed significantly towards fulfillment of the targets and I am happy to place on record my appreciation to each one of them. We have received all required support from the Fisheries Division of the Indian Council of Agricultural Research (ICAR). I wish to place on record my thanks to Dr. K. Gopakumar, Deputy Director General (Fy.), Dr. A.D. Diwan, Assistant Director General (M.Fy.) and Shri Anil Agarwal, Principal Scientist (M.Fy.) for their continued support.

Cochin
June 2001

MOHAN JOSEPH MODAYIL
DIRECTOR

हिंदी सारांश

वर्ष 2000-2001 के दौरान केंद्रीय समुद्री मात्स्यिकी अनुसंधान संस्थान ने 65 इनहाउस परियोजनाएं और 24 प्रायोजित परियोजनाएं कार्यान्वित कीं. ये राष्ट्रीय कृषि तकनोलजी परियोजनाओं के अतिरिक्त हैं.

भारत की समुद्री मछली का आकलित उत्पादन 2.70 मिलियन टन था. इसमें वेलापवर्ती और तलमज्जी वर्गों का अनुपात 50:50 था. इन में लगभग 66% पकड यंत्रीकृत पोत, 26% मोटोरीकृत एकक और 8% अयंत्रीकृत एककों के ज़रिए प्राप्त हुई थी. वर्ष के दौरान 3.67 लाख टन के साथ तारलियों की पकड में 52% वृद्धि देखी गई. बंबिल, पर्चस, क्रॉकेर्स, पेनिआइड और नोन पेनिआइड झींगों, शीर्षपादों और फीतामीनों की पकड में 2 से 47% की बढ़ती दिखाई पडी. बांगडा व लेस्सर सारडीनों की पकड में पिछले वर्ष की तुलना में क्रमशः 75,000 टन और 46,000 टन की कमी हुई थी.

उत्तर-पश्चिम तट से देश की 40% मछलियों का उत्पादन हुआ था. दक्षिण-पश्चिम तट का योगदान 32% , दक्षिण-पूर्व तट का योगदान 22% और उत्तर-पूर्व तट का योगदान 6% था. पश्चिम तट की मुख्य पकड तारलियों के तरुण थी. इसका प्रतिशत 20 था जो अप्रैल से नवंबर के महीनों में मूलतः प्राप्त हुआ था. कर्नाटक तट में *स्टोलिफोरस डेविसी* प्रचुर मात्रा में उपलब्ध हुआ था. केरल में *एस. कमेर्सोनी* भारी मात्रा में उपलब्ध हुआ था. सुरमई पकड का 65% गिलजालों से और 17% ट्राल और अन्य संभारों से प्राप्त हुई थी. पूर्व तट में *एस. कमेर्सन* की वार्षिक आकलित पकड 14,000 टन और पश्चिम तट में 22,000 टन थी. महाद्वीप में ट्यूना मछली मुख्यतः ड्रिफ्ट गिल जालों द्वारा पकडी गई थी. मिनिकोय में पिछले वर्ष की तुलना में ट्यूना पकड में कमी दिखाई पडी.

बांगडा मछली मुख्यतः कर्नाटक से पकडी गई थी. प्राप्ति का प्रतिशत 39 था. केरल में मिला इसका प्रतिशत सिर्फ 17 था.

उत्तर - पश्चिम तट में बंबिल की पकड में 40% की कमी दिखाई पडी. मत्स्यन प्रयास 90% बढ़ाने पर भी इस मछली की पकड में कोई वृद्धि लाई जा न सकी. पकडी गई अवस्था में इस मछली की लंबाई केवल 50 मि मी थी. फीतामीन की पकड केलिए गुजरात, महाराष्ट्र और कर्नाटक में चौथी तिमाही, केरल में तीसरी और आन्ध्राप्रदेश में पहली तिमाही अनुकूल मौसम थे. पकडी गई फीतामीनों में 98% *ट्रैक्यूरस लेप्टचूरस* थी.

करंजिडों का प्रमुखतः ट्राल द्वारा विदोहन किया जाता था. इसके अलावा कोष संपाशों, ड्रिफ्ट जालों और कांटा डोर भी इसके विदोहन के लिए प्रयुक्त किया जाता है. ट्राल पकड का मुख्य भाग स्कड *डेकाप्टीरस रसली* था. गिल जालों में होर्स माकरल *एम. कोर्डियेला* और कोष संपाश में *डी. माक्रोसोमा* मुख्य पकड थी.

तलमज्जी पख मछलियों की पकड में पिछले वर्ष की तुलना में 1.6 लाख टन की बढ़ती दिखाई पडी. गुजरात तलमज्जी पख मछलियों की पकड केलिए अनुकूल स्थान देखा गया.

उपास्थिमीनों में सुरा मुख्य पकड थी. इसका प्रतिशत है 65. पकड में रे मछली 33%, स्केट मछली 3% थी. सुराओं की पकड में 11% और स्केट और रे

मछलियों की पकड में क्रमशः 3% और 13% की घटती दिखाई पडी. उपास्थिमीनों की पकड के लिए मूलतः ट्रालों का उपयोग किया गया था. महाराष्ट्र में पकड का 96% , केरल में 72% और तमिलनाडू में 79% ट्रालों के ज़रिए प्राप्त किया था. महाराष्ट्र और केरल में मिली प्रचुर जाति *स्कोलियोडोन लॉटिकोडस* थी. *कारकारिनस मेलानोप्टीरस* तमिलनाडू की प्रचुर जाति थी. केरल के गिल जालों में *सी . मेलानोप्टीरस* प्रचुर मात्रा में मिली थी. ट्राल अवतरण में 10 जातियों की रे मछली दिखाई पडी थी.

ग्रूपर मछलियों की पकड में पिछले वर्ष की तुलना में 60% की बढ़ती दिखाई पडी. गुजरात से सबसे अधिक पकड प्राप्त हुई थी इसके पीछे महाराष्ट्र और तमिलनाडू भी आये थे. *ई. डयाकांतस* के तरुण पकड में बडी मात्रा में उपलब्ध हुए थे.

स्नापर मछलियों के अवतरण में पिछले वर्ष की तुलना में 3% की घटती दिखाई पडी. 75% स्नापरों का योगदान तमिलनाडू और कर्नाटक से हुआ था. पिगफेस ब्रीम के कुल अवतरण का 90% तमिलनाडू से प्राप्त हुआ था, कुल अवतरण 11,000 टन था.

सूत्रपख ब्रीम के अवतरण में पिछले वर्ष की तुलना में 43,000 टन की बढ़ती हुई थी. पकड का मुख्य भाग माने करीब 40% गुजरात से प्राप्त हुआ था. आंध्रा प्रदेश में अवतरण का श्रृंगकाल अक्तूबर-दिसंबर, तमिलनाडू में जून-जुलाई, केरल में मई-जून, कर्नाटक में सितंबर-अक्तूबर, महाराष्ट्र में फरवरी-मार्च और गुजरात में नवंबर-दिसंबर था. पकड का मुख्य भाग *नेमीप्टीरम जापोनिकस* और *एन. मीसोप्रियोन* मछलियाँ थी.

मुल्लनों का 79% पूर्वी तटों से प्राप्त हुआ था. इस में 69% तमिलनाडू का योगदान था. कुल मछली पकड में क्रोकर मछलियों का योगदान 6.9 % था जो कि पिछले वर्ष की तुलना में 8% की बढ़ती दिखाती है. गुजरात से 50% मछलियों का अवतरण हुआ था.

पिछले वर्ष की तुलना में तुम्बिलों के उत्पादन में 5% की बढ़ती हुई. आंध्रा प्रदेश, महाराष्ट्र और गुजरात की प्रचुर मछली *सॉरिडा तुम्बिल* और तमिलनाडू की *एस. अंडोस्क्वामिस* थी.

पिछले वर्ष की तुलना में पॉम्फ्रेट मछलियों के अवतरण में केवल एक प्रतिशत की बढ़ती हुई थी. इसकी पकड मुख्यतः ट्राल, गिल जाल और डोल जाल के ज़रिए हुई थी. इसमें सबसे प्रचुर जाति *पी.अर्जेन्टियस* थी. उच्चतम पकड गुजरात और महाराष्ट्र से हुई थी. महाराष्ट्र में ट्राल में पकडी गई 22.2 मिलियन मछलियाँ *(पी. अर्जेन्टियस*) अप्रौढ़ और कम लंबाई की अवस्था की थी. गिल जालों में मिली 90,000 मछलियाँ भी अप्रौढ और कम लंबाई की अवस्था की थी. बुल्स आइ मछलियों में मिली एकमात्र जाति *पी. हामरस* थी. इसे गुजरात, महाराष्ट्र और केरल से प्राप्त हुआ था. केरल में अप्रैल- जून के दौरान इस जाति का अंडजनन हुआ था. चपटी मछलियों में *सी. माक्रोस्टोमस* उत्तर केरल और दक्षिण कर्नाटक में प्रचुर थी. दक्षिण केरल में *सी. बेलिनीटस* और दक्षिण-तमिलनाडू में *सी. माक्रोलेपिडोटस* प्रचुर थी. मात्स्यिकी में गोट फिशों की 8 जातियाँ देखी गई. *लैक्टारियस लैक्टारियस* का भारी अंडजनन जनवरी-फरवरी के महीनों में कर्नाटक तटों में देखा गया. देश के विभिन्न भागों में हुए ट्राल अवतरण में मछलियों के तरुण और अन्य खाद्येतर जीवजात पर्याप्त मात्रा में देखा गया.

कवचप्राणी मछलियों के 17% का अवतरण पश्चिम तट में हुआ था. इनमें 72 % पेनिआइड झींगे थे. ट्रालरों द्वारा प्राप्त पेनिआइड झींगों का केवल 2% बडे आकार के थे. केरल में नवंबर - अप्रैल के दौरान गहरे समुद्र में मत्स्यन बढ़ाने की कोशिश की गई और पहली बार इस प्रयास से 23,000 टन गहरा सागर झींगा पकडा जा सका. पूर्वी तटों में पेनिआइड झींगों की पकड में घटती की प्रवणता दिखाई पडी. तमिलनाडू और आंध्रा प्रदेश में घटती क्रमशः 6% और 10 % थी.

पिछले वर्ष की अपेक्षा नॉन पेनिआइड झींगों की पकड में 1.57 लाख टन के साथ 2,000 टन की बढ़ती हुई थी. इस पकड का 65% महाराष्ट्र और गुजरात से मिला था.

इस वर्ष के दौरान 24,000 टन महाचिंगटों का अवतरण हुआ था. इस में 42% गुजरात का योगदान था, बाकी क्रमशः महाराष्ट्र, केरल और तमिलनाडू का है. केरल और कर्नाटक में 200-400 मीटर गहराइ से *पी. सेवली* का मत्स्यन होता है.

कर्कटों का कुल योगदान 48,000 टन था. इसका फीसदी वितरण है गुजरात से 43%, तमिलनाडू से 28%, केरल से 12% और आंध्रा प्रदेश से 6%. सेमीसुलकेटस झींगों में किए गए परीक्षणात्मक बीज उत्पादन की एक बारी में मिला उच्चतम पश्च डिंभकों का उत्पादन एक मिलियन था. मान्नार खाडी में 2.2 मिलियन पश्च डिंभकों का समुद्र रैंचन किया गया था. प्रयोगशाला में पालित मोनोडोन झींगों के अंड शावकों से तीसरी पीढ़ी का सफलतापूर्वक विकास किया गया.

शीर्षपादों के अवतरण में पिछले वर्ष की तुलना में 21% की बढती हुई थी. इनमें स्क्विड मछली प्रचुर थी. द्विकपाटियों और जठरपादों का उत्पादन करीब 2 लाख टन था. विन्डोपेन शुक्तियों का बीजोत्पादन किया जा सका. *क्रासेस्ट्रिया माड्रासेन्सिस* में किए गये *ट्रिप्लोइडी* में 63% इन्डक्शन पाया गया. मोती संवर्धन तकनोलजी के उन्नयन के लिए किए गए परीक्षणों ने व्यक्त किया कि पंजरा पालन रीति में प्रत्येक पंजर केलिए अनुयोज्य संभरण सांद्रता 1,000 जीवी है. शंबु और खाद्य शुक्ति के वाणिज्यिक पालन में 300 टन का उत्पादन संवर्धन देखा गया. कटल फिश *एस.इनेर्मिस* के एफ 5, एफ 6 और एफ 7 पीढी का विकास करके टूटिकोरिन में समुद्र रैंचन किया गया. परीक्षणों के अनुसार उपतट मोती पालन के लिए अनुयोज्य तापमान 22 से 35°C देखा गया.

पर्यावरणीय अभिलक्षणों पर मानीटरन जारी रखा और आवश्यक डेटाओं का रूपायन किया गया.

वर्ष 1999 के 3.4 लाख टन की तुलना में उड़ीसा तट में मार्च, 2000 में 7,00,000 ओलीव रिडले कच्छपों का नीडन हुआ था.

दक्षिण-पश्चिम तट में गिल जाल और कांटा डोर के ज़रिए कच्छपों की आकस्मिक पकड भी हुई थी. समुद्री ककडी *एच.स्काब्रा* के करीब 20,000 डिंभकों का उत्पादन किया गया था. इनमें से करीब 10% ने *डोलियोलेरिया* अवस्था प्राप्त की थी . ग्रूपरों के किशोरों केलिए उनके 10% शरीर भार के समतुल्य खाद्य अनुकूल देखा गया. रोगपीडित झींगा ऊतक से वाइट स्पोट रोग कारक वाइरस के विलगन का तरीका विकसित किया गया. केरल की तटीय मेखला में मात्स्यिकी विस्तार के ज़रिए तटीय समुदाय के सशक्तीकरण कार्यक्रम के अंदर कर्कट पालन और संयोजित मछली पालन रीतियों का निदर्शन किया गया. लाभदायक आनायन करने के संबंध में किए गए आकलन द्वारा व्यक्त हो गया कि प्रति ट्रिप के परिचालन लागत में अंतर है. मंडपम में प्रति यात्रा पर होनेवाला लागत 4,000 रु है तो शक्तिकुलंगरा तक पहुँचते यह 7,400 रु हो जाता है . वैसे आय में भी अंतर है. यह क्रमशः 1,630 से 2,960 रु है. *एफ ओ आर वी* सागर संपदा द्वारा पश्चिम तट में चलाए गये अन्वेषणात्मक सर्वेक्षणों से व्यक्त हो गया कि 300-400 मी गहराई से मिलनेवाली पकड का 25.5% गभीर सागर झींगें है . आन्डमान समुद्र में 200-500 मी गहराई क्षेत्र से मध्यवेलापवर्ती मछलियों की प्रति घंटा 215 कि ग्रा मछलियों की पकड दर आकलित की गयी. भारतीय कृषि अनुसंधान परिषद के मोती उत्पादन आवर्ती निधि कार्यक्रम के अंदर 2,200 वाणिज्यिक वर्ग के मोतियों का उत्पादन किया गया . विषैला शैवालों पर किए गए अध्ययन में 16 वर्गों और 67 जातियों के पादपप्लवकांश निकाले गये . एन ए टी पी परियोजना के कार्य प्रगति पर है .

शिक्षा कार्यक्रम में दो पी एच. डी उपाधि प्रदान की गयी और छ अध्येताओं के परिणाम उद्घोषित किए जानेवाले है. एम. एफ. एस सी का अध्यापन

कार्यक्रम विधिवत् चलाया गया.

कृषि विज्ञान केन्द्र में चलाये गये 64 प्रशिक्षण कार्यक्रमों से 1,369 प्रशिक्षणार्थियों ने लाभ उठाए. प्रशिक्षक प्रशिक्षण केन्द्र में 10 प्रशिक्षण कार्यक्रम आयोजित किए गए जिनमें 190 प्रतिभागियों ने भाग लिया.

संस्थान के वैज्ञानिकों ने विभिन्न परिचर्चाओं, संगोष्ठियों/कार्यशालाओं में भाग लेते हुए प्रपत्र प्रस्तुत किए.

वर्ष के दौरान चार परामर्श कार्यक्रम पूरा किए गए और छः जारी रखे गये.

अनिवार्य उपकरणों को जोडते हुए अनुसंधान के लिए आवश्यक अवसंरचनाओं का विकास किया गया.

EXECUTIVE SUMMARY

The Institute implemented 65 in-house projects and 24 sponsored projects, besides implementing programmes under the National Agriculture Technology Project.

Marine fish production in India was estimated as 2.70 million tonnes, the pelagic and demersal groups contributing 50:50. About 66% of the landings were fished by mechanised vessels, 26% by motorised units and 8% by non motorised units. During this year, the oil sardine showed the phenomenal increase of 52% in the landings with the estimated catch at 3.67 lakh tonnes. The Bombay-duck, perches, croakers, penaeid and non penaeid prawns, cephalopods and ribbon fishes registered increase ranging from 2 to 47%. The landings of mackerel and lesser sardines declined by 75,000 t and 46,000 t when compared to those of the previous year.

Northwest coast contributed to 40% of the country's marine fish production followed by southwest coast (32%), southeast (22%) and northeast (6%). In the case of oil sardine, the juveniles (less than 100 mm size) formed 20% of the catch along the west coast. The recruitment in the species extended from April to November along west coast and March to August along east coast. *Stolephorus devisi* was dominant among anchovies along Karnataka. In Kerala, the MSY of *S. commersoni* was estimated as 11,830 t. In the case of seerfish, gill net accounted for 65% of the catch followed by trawl (17%) and the rest by other gears. The annual stock of *S. comberomorus commerson* was estimated as 14,000 t along the east coast and 22,000 t along west coast. Drift gill net contributed to the maximum of the tuna catch along the mainland coast. At Minicoy, the tuna landings showed decline of about 37% over previous year. In the mackerel, Karnataka contributed about 39% followed by Kerala (17%) and other States.

Along the northwest coast, the Bombay-duck landings decreased by 14% eventhough there was over 90% increase in the fishing effort. The average length at recruitment was about 50 mm in this region. The ribbonfish fishery showed peak during the 4th quarter in Gujarat, Maharashtra and Karnataka, 3rd qr. in Kerala and 1st qr. in Andhra Pradesh. *Trichiurus lepturus* formed 98% of the ribbonfish catch.

The carangids were exploited by the trawl predominantly, followed by purseseine, drift net, hooks and lines. The scad *Decapterus russelli* was the most dominant species in the trawl landings. In gill nets, the horse mackerel, *M. cordyla* was abundant and in purseseine, *D. macrosoma* was abundant in the purseseine.

The total demersal fin fish landing was estimated at 7.6 lakh t which showed an increase of 1.6 lakh t over the previous year. Gujarat accounted for bulk of the demersal fin fish catch.

In the elasmobranchs, sharks formed 64% followed by rays (33%) and skates (3%). There was an increase of 11% in the shark landings whereas skates and rays declined by 3 and 13% respectively. In Maharashtra, 96% of the elasmobranchs landed, were fished by trawl, 72% in Kerala and 79% in Tamilnadu. *Scoliodon laticaudus* was most abundant in Maharashtra and Kerala and *Carcharinus melanopterus* in Tamilnadu in the trawl, *C. melanopterus* was abundant in gillnet in Kerala. 10 species of rays were recorded in the trawl landings.

Groupers registered an increase of 60% over the previous year, with Gujarat contributing the maximum followed by Maharashtra, Tamilnadu and others. *E. diacanthus* was the most dominant species with the bulk of the landings represented by juveniles.

The landings of snappers showed to marginal decline of 3% over the previous year, Tamilnadu and Karnataka landed over 75% of the snappers in India. In the case of pigface bream Tamilnadu accounted for 90% of the total landings of 11,000 t in the country.

In the case of threadfin breams, landings showed increase of 43,000 t over the previous year with Gujarat contributing to the bulk of the production (about 40%). Peak period of landings was October – December in Andhra Pradesh, June – July in Tamilnadu, May – June in Kerala, September-October in Karnataka, February-March in Maharashtra and November-December in Gujarat. *Nemipterus japonicus* and *N. mesoprion* formed bulk of the landings.

79% of the silverbellies were landed along the east coast with Tamilnadu contributing 69% of the all India catch. The croakers accounted 6.5% of the total marine fish landings showing 8% increase over previous year. Gujarat accounted for nearly 50% of the landing of the country.

The production of lizardfish showed an increase of about 5% over the previous year. *Saurida tumbil* was the most abundant in Andhra Pradesh, Maharashtra and Gujarat and *S. undosquamis* in Tamilnadu.

The pomfret landings showed an increase of only 1% over the previous year; these species were exploited by trawl, gillnet and *dol* net. *Pampus argenteus* was the most dominant species. Gujarat and Maharashtra accounted for maximum landings. It is estimated that in Maharashtra, 22.2 million fishes (of *P. argenteus*) were less than the length at first maturity in the trawl landings. In the case of gillnet about 90,000 fish were less than length at first maturity. *Priacanthus hamrur* was the only species among Bull's eye in Gujarat, Maharashtra and Kerala. This species spawned during April – July in Kerala. Among flat fishes *C. macrostomus was* dominant along North Kerala and South Karnataka, *C. bilineatus* along southern Kerala and *C. macrolepidotus* along southern Tamilnadu. Eight species of goatfishes contributed to the fishery. In *Lactarius lactarius* peak spawning appears to take place during January-February along the Karnataka coast.

The crustaceans accounted for 17% of the marine fish landings. West coast accounted for 72% of penaeid prawns landed. Large-sized species formed only 2% of the penaeid prawn landings in the trawlers. A concerted fishing effort was made in relatively deeper waters during November-April in Kerala and an estimated 21,000 t of deep-sea prawns were harvested for the first time. Along the east coast, penaeid prawn fishery declined by about 6% in Tamilnadu and 10% in Andhra Pradesh. The non-penaeids showed a 2000 t increase over the previous year with an estimated landing of 1.57 lakh. Gujarat and Maharashtra accounted for 66% of the catch.

Of about, 2400 t of lobsters landed, Gujarat accounted for 43% followed by Maharashtra, Kerala and Tamilnadu. *P. sewelli* was fished in the 200-400 m depth range off Kerala and Karnataka. The landing of crab was about 48,000 t with Gujarat accounting for 43% followed by Tamilnadu (28%), Kerala (12%) and Andhra Pradesh (6%). In the experimental seed production of the prawn *P. semisulcatus,* a maximum of 1 million post-larvae were produced in a run. 2.2 million post-larvae were searanched in the Gulf of Mannar. The third generation of *P. monodon* seed was produced from the domesticated broodstock.

The cephalopod landing registered an increase of 21% over 1999. Squids contributed maximum. The potential yield of bivalves and gastropods was estimated as about 2 lakh t. Seed production of window-pane oyster was achieved.

Triploidy was introduced in *Crassostrea madrasensis* and 63% induction was achieved. In the upgradation of pearl culture technology, the research work carried out revealed that stocking density of 1,000 per cage would give higher survival and growth. In the commercial culture of mussel and edible oyster, a production 300t was achieved. F5, F6 and F7 generations of cuttlefish *S. inermis* were produced and searanched at Tuticorin. The experiments on the influence of temperature on growth of pearl oysters in the onshore pearl culture, revealed that 22-35^{0}C range would be suitable for achieving satisfactory growth rate.

The monitoring of environmental characteristics in the inshore waters continued and all relevant data generated.An estimated 7,00,000 Olive ridley turtle nested in March 2000 along Orissa coast against the 3.4 lakh in 1999.Gillnets and hooks and lines were responsible for incidental catches of turtles along southwest coast.

About 20,000 larvae of seacucumber, *H. scabra* were produced of which about 10% attained *Doliolaria* stage. In grouper juveniles, optimum feeding rate was found to be 10% body weight (fresh sardines). A simplified protocol for the isolation of whitespot baculovirus DNA template from the infected shrimp tissue was perfected. In the programme of empowerment of coastal communities through fisheries extension, crab farming and an integrated fish culture were demonstrated in the farmer's fields in Kerala. In the area of economics of trawling, it was observed that the operating coast/trip varied from about Rs.4,000 in the Mandapam region to about Rs. 7,400 in the Sakthikulangara region for a single day trip and the net operating income/trip ranged from Rs.1630 to 2960 respectively. In the exploratory surveys by FORV *Sagar sampada* along west coast, deep- sea prawns formed 25.5% of the catch at depths of 300-400 m. In the Andaman Sea, average catch rates of 215kg/hr was obtained in the 200-500 m depth range with the major component of mesopelagic fishes. In the ICAR Revolving fund programme of production of pearls, about 2200 commercial grade pearls were produced. In the area of toxic algal blooms 16 genera and 67 species of phytoplankters were identified. The work in NATP projects progressed well.

In the education programme, two candidates were awarded Ph.D. degree and six candidates are awaiting results. The teaching programme in the M.F.Sc. was carried out as per schedule. The KVK conducted a total of 64 training programmes and 1369 persons were benefited by this. The TTC conducted 10 training programmes for 190 participants.

Four consultancy programmes were completed during the year and six programmes were continued.

INTRODUCTION

India is endowed with a long coastline of 8,129 km, 0.5 million sq km of continental shelf, 2.02 million sq km of EEZ and an estimated annual Marine Fishery Resource Potential of 3.9 million tonnes. The vast areas all along the coastline offer ideal sites for seafarming and coastal mariculture. The Indian marine fisheries sector plays a very important role in supplying protein-rich food to the increasing population, employment generation and foreign exchange earning. The present marine fisheries scenario in India is characterised by declining yields from the inshore waters, increasing conflicts between different resource users, increasing demand for fish food for domestic consumption and export and, prospects for large scale seafarming and coastal mariculture. This warrants greater and more effective R&D efforts to enable implement suitable action plans for sustained marine fisheries and mariculture development.

The Central Marine Fisheries Research Institute (established in 1947) is the nodal agency in India, responsible for research support in marine fisheries development. Over the period of half a century since its inception, the CMFRI grew significantly in its size and stature by building up a fairly adequate research infrastructure and recruiting suitably qualified R&D staff. The Institute's multidisciplinary approach to research in marine capture and culture fisheries has won the recognition as a premier Institute comparable to any well-established laboratory in the world.

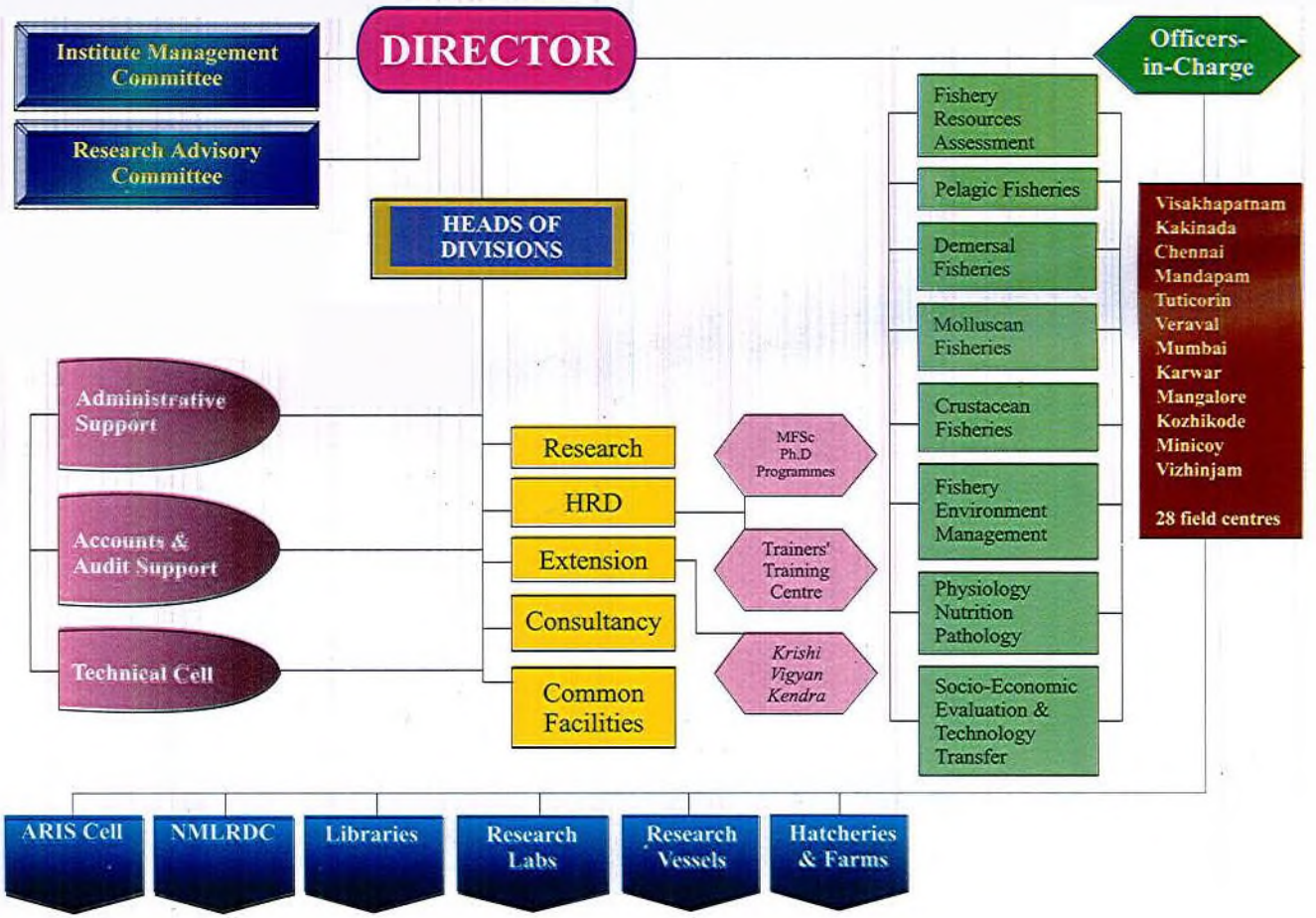
To accomplish its mandate, the Institute monitors the landings on a continual basis from all along the country's coast, conducts researches on characteristics of exploited marine fish stocks; carries out exploratory surveys and assessess the under- and unexploited resources, develops seafarming techniques, undertakes research in fishery environmental characteristics and sea-dynamics and conducts postgraduate education programmes leading to M.F.Sc. and Ph.D. degrees. Studies are also conducted on economics of fishery enterprises and socio-economic conditions of fisherfolk.

The organisational set-up

To effectively carry out these tasks, the Institute has established a Regional Centre at Mandapam Camp, Research Centres at Minicoy, Veraval, Mumbai, Karwar, Mangalore, Calicut, Vizhinjam, Tuticorin, Chennai, Kakinada and Visakhapatnam and 28 Field Centres all along the coast. The entire activity is coordinated by the Headquarters at Cochin. The Institute has, over the years, built up laboratory and field facilities for carrying out research programmes and has been upgrading the same to meet the changing and additional requirements. The sanctioned staff strength of the Institute is: Scientific 192, Technical 421, Ministerial 170, Auxiliary 6 and Supporting 337.

The multidisciplinary researches in capture and culture fisheries are conducted under eight Divisions: Fisheries Resources Assessment, Pelagic Fisheries, Demersal Fisheries, Crustacean Fisheries, Molluscan Fisheries, Fishery Environment Management, Physiology, Nutrition and Pathology and Socio-economic Evaluation and Technology Transfer. Interdivisional and Interinstitutional programmes with collaborating agencies are carried out for greater utilisation of expertise and facilities. Besides, the Institute also takes up short-term research projects on important and priority areas

CMFRI ORGANOGRAM



through *ad hoc* research projects funded by outside agencies in the country and abroad and offers consultancy services to the clients from Government organisations as well as private industry.

farmers, agricultural farmers and farmwomen and the Trainers' Training Centre to the officials of state and central governments, banks, societies and autonomous bodies interested in fisheries development.

The Mandate

- Assessment and monitoring of the status of the exploited and unexploited fish stocks in the Indian EEZ, the contiguous international waters (for the mesopelagics) and the Southern Ocean (for Antarctic krill and finfish) in relation to fishery independent and fishery dependent factors; evaluation of the technoeconomics and socioeconomics of marine fishing operations

- Development of suitable technologies for seafarming of finfish, shellfish, seaweeds and other cultivable marine organisms; evaluation of the technoeconomics and socioeconomics of mariculture operations; upgradation of technologies through R&D in frontier areas in Biotechnology, Nutrition, Pathology and Endocrinology

- Monitoring the health of the coastal ecosystems, particularly the endangered ecosystems in relation to artisanal fishing, mechanised fishing and marine pollution

- Transfer of viable seafarming technologies through extension education, specialised training and consultancy services

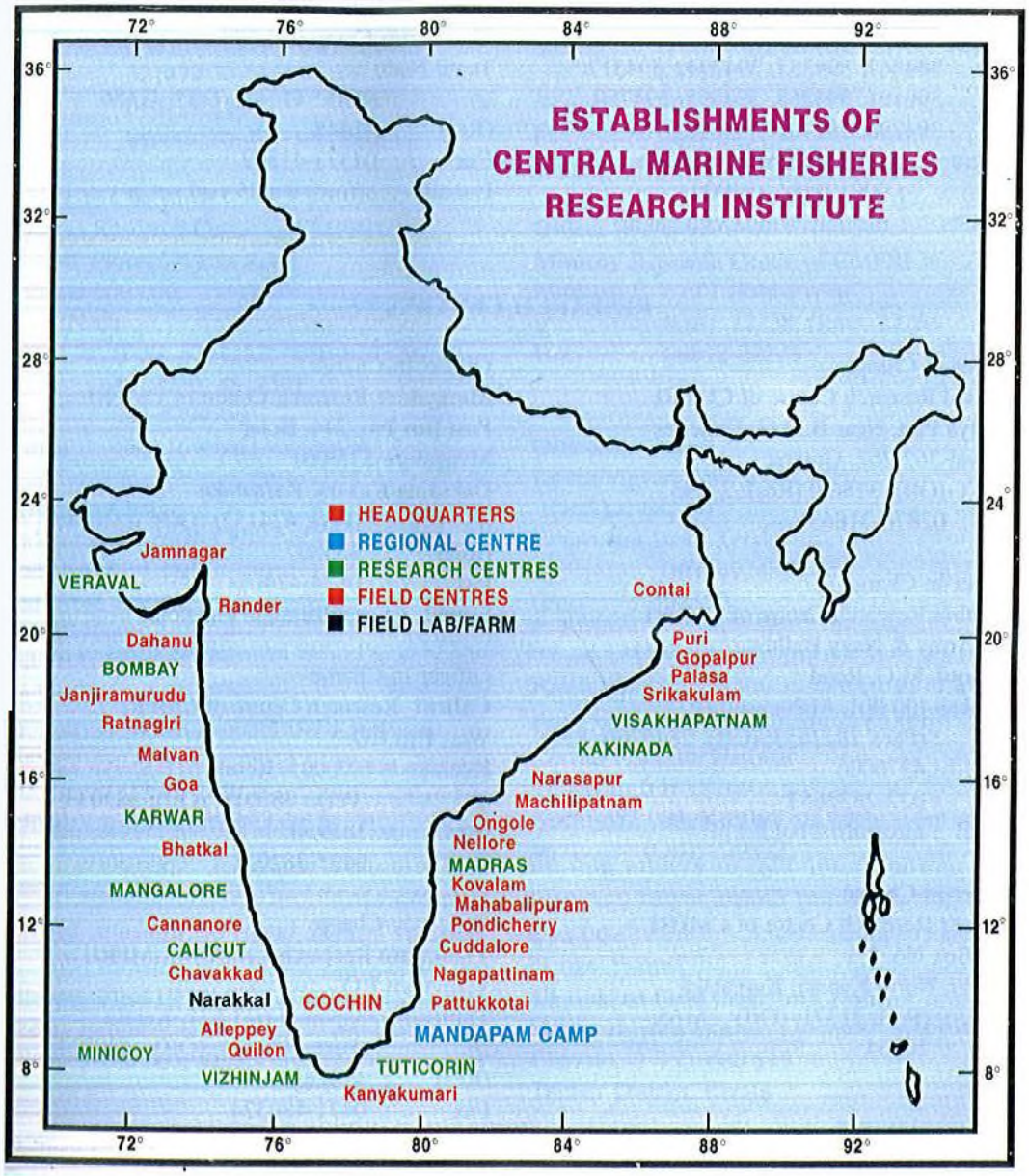
- Postgraduate education in marine fisheries and mariculture leading to M.F.Sc. and Ph.D. degrees; introduction of new subjects in frontier areas and establishment of another Deemed University in Fisheries

Under the Postgraduate Programme in Mariculture, the Institute organises M.F.Sc. and Ph.D programmes of the Central Institute of Fisheries Education, Mumbai, a Deemed University under the ICAR. The teaching programme is carried out by the scientists of the Institute.

The *Krishi Vigyan Kendra* imparts training in mariculture, agriculture, animal husbandry and other related subjects to fish

The Library and Documentation Section provides reference facilities to research staff and students of the Institute as well as to visiting scientists both within and outside the country.

The results of researches carried out in the Institute are published in various Journals. Besides, the Institute brings out Bulletins, Special Publications and Marine Fisheries Information Service. The CMFRI also publishes the *Indian Journal of Fisheries*.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Cannanore
CALICUT
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VIZHINJAM
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Officer-in-Charge
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Kochi-682 005, Kerala
✆ : (Off): 220892

FIELD CENTRES

Alleppey Field Centre of CMFRI
Geetha Building, Kalarcode
Alleppey-688 005, Kerala

Bhatkal Field Centre of CMFRI
1st Floor, Behind Ganesh Bhavan
Building, 27, Kidwai Road
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Chavakkad Field Centre of CMFRI
Edakkazhiyoor P.O.
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Trichur District, Kerala

Contai Field Centre of CMFRI
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Contai 721 401, Midnapore District
West Bengal

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Janjira Murud Field Centre of CMFRI
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Tamil Nadu

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Malwan-416 606, Maharashtra

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Nagappatinam Field Centre of CMFRI
C/o Inspector of Fisheries
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Tamilnadu

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New A.C. Bubba Reddy Statue
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Srikakulam District
Andhra Pradesh

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Pattukottai-614 601
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Pondicherry Field Centre of CMFRI
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Pondicherry-605 001

Puri Field Centre of CMFRI
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Near Hotel Sea 'n' Sand
Chakratirtha Road
Puri-752 002, Orissa

Quilon Field Centre of CMFRI
Municipal Stadium Buildings
Ward No. VII, Door No. 737
Quilon, Kerala

Rander Field Centre of CMFRI
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Ratnagiri Field Centre of CMFRI
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Devchand Nivas,
Lower Lane, Ratnagiri-415 612
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Srikakulam Field Centre of CMFRI
Door No. 4-1-23/1 Opp. Govt. Employees
Co-operative Stores Ltd., No. A-675,
Srikakulam-532001
Andhra Pradesh

BUDGET 2000-2001

(Rs. in lakhs)

S.No.	Budget Heads	RE for 2000-2001	Expenditure Incurred
		PLAN	
1.	T.A.	35.00	35.00
2.	Other charges including equipment	200.00	214.83
3.	Information Technology	9.00	8.84
4.	Replacement of old Equipments under one time catchup grant	50.00	35.35
5.	Works		
	Major works &	90.00	32.71
	Renovation of Building		57.29
6.	Other items	22.00	20.22
7.	HRD	1.00	2.76
	TOTAL	**407.00**	**407.00**
		NON-PLAN	
1.	Estt. Charges	1240.00	1240.00
2.	O.T.A.	1.20	1.20
3.	T.A.	13.00	13.00
4.	Other Charges	96.80	96.80
5.	Works	38.00	38.00
6.	Other items	2.00	2.00
	TOTAL	**1391.00**	**1391.00**

LIBRARY AND DOCUMENTATION SECTION

During the period under report 55 books, 20 CD-ROMs and 1306 issues of journals were added to the library at Headquarters. Essential books and journals were also acquired for libraries at Regional and Research Centres. Inter-library loan and inter-library collaboration of publications were continued. Reference and reprographic facilities were provided to visiting scientists, scholars and others.

The Library stocks and distributes the Institute publications.

The following publications were issued during the period:

1. *Indian Journal of Fisheries* Vol. 46 No. 3,4 (1999)
2. *Indian Journal of Fisheries* Vol. 47 No. 1,2,3,4 (2000)
3. *Marine Fisheries Information Service* T&E Ser. Nos. 157-166
4. CMFRI Newsletter Nos. 87-90
5. CMFRI Annual Report 1999-2000
6. CMFRI Special Publication Nos. 69, 70, 12 (Revised)
7. Book – Marine Fisheries Research and Management

VESSEL MANAGEMENT CELL

The *Cadalmin-VI* based at Kochi was utilised for collection of plankton samples, and other environmental studies in the inshore and backwaters of Kochi. *R.V. Sagitta*, the vessel based at Mandapam Camp was utilised for collection of seaweeds and hydrographic data. The vessel was also utilised for consultancy projects at Tuticorin. *Cadalmin-IV* at Tuticorin is under repairs. *Cadalmin-II*, stationed at Mandapam Camp and *Cadalmin-IX* stationed at Cochin, which served the full life of a wooden vessel of 20-25 years are decommissioned.

THE OFFICIAL LANGUAGE IMPLEMENTATION PROGRAMME

The year 2000 was very important to Hindi, being the Golden Jubilee Year of Official Language. The Official Language Implementation Committee of the Institute chalked out programmes for implementation during the year as per these guidelines and a summary of activities undertaken during the year is given below.

1. **Bilingual use:** Use of stationery items, issue of Section 3(3) documents and release of procedural literature of the Institute were continued.

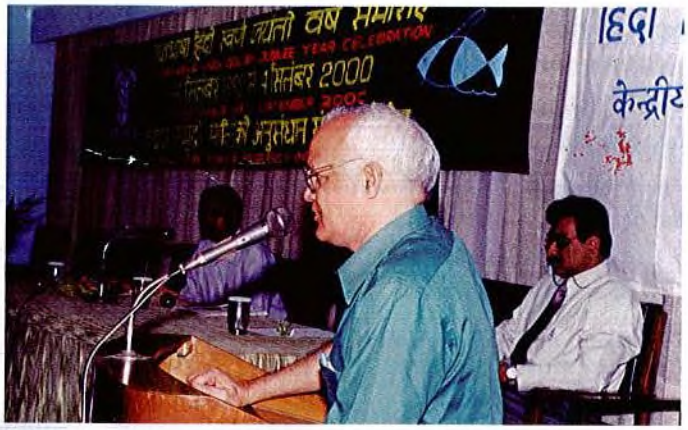
Hindi Poets Meet at Headquarters (On the dias from right to left Shri K.L. Mohana Varma, eminent Malayalam writer, Dr.G. Sudhakara Rao, Principal Scientist, CMFRI, Dr.P.V. Vijayan, Former Head, Department of Hindi, Cochin University, Dr.D.P. Thomas, Principal, Hindi Prachar Sabha, Ernakulam

2. **Promoting the use of Hindi:** The programmes implemented during the year are: 1) obligatory Hindi training of staff under which 5 employees have passed the various Hindi examinations 2) Conduct of Hindi Workshop under which 4 Hindi

Workshops were organised at the Calicut, Minicoy, Tuticorin Research Centres and at Headquarters, Cochin in which altogether 94 employees were trained. 3) Library service under which 32 new books were added to the Hindi library and popular / departmental periodicals subscribed and displayed. 4) General Hindi correspondence under which 15% correspondence was made in Hindi and all the letters received in Hindi were replied to in Hindi. 5) under the postgraduate programme, abstracts of 8 M.F.Sc and one Ph.D thesis were submitted in Hindi 6) Hindi day was observed at Headquarters by releasing inspiring message and the Hindi day / week was observed at the Centres of CMFRI.

ii) Golden Jubilee Year planner:

a) **Millenium Quiz**: On the emerging scenario of globalisation and Information Technology, highlighting the millenium concepts on language, a quiz in Hindi was conducted in January 2000.



Hindi Day Celebration: Shri V.N. Rai, Chairman & Managing Director, FACT, Udyogamandal delivering the address

Hindi Day Celebration: Prof. (Dr.) Mohan Joseph Modayil, Director, CMFRI addressing the staff

b) **Creative literature propagation:** The Institute sponsored a Hndi ***"Poets Meet"*** in March 2000 to propagate original writing in Hindi deviating from the official set-up of translation . In this programme 13 selected poets in and around Cochin city presented poems. The linguistic harmony concept was also highlighted alongwith this by presenting poems in 7 National languages.

c) **Golden Jubilee Year Special Release:** As a hall mark of concluding the Golden Jubilee Year of Hindi, and taking a stock of work undertaken hitherto, a

3. **Progressive use of Hindi**

i) Popularisation of science literature in Hindi : Under this mission 4 research papers on different topics were presented / published at CIFE, Bombay, CIFT Cochin and Trivandrum TOLIC.

Dr.N.G.K. Pillai, Head, PFD receiving the Rajbhasha Rolling Trophy of Cochin TOLIC for the excellent Official Language Implementation for the year 1999 – 2000 from the Chief Commissioner of Income Tax, Cochin

special publication named ***Matsyagandha*** was released in December 2000. The content mainly elucidates the structure, functions and contributions of the Institute by giving a new dimension to the functional Hindi language on Marine Fisheries Research. Matters of general intrest are also included in the publication.

4. **Recognition:** The Institute won the *Rajbhasha* Rolling Trophy of the Cochin TOLIC for the 4th time for the excellent Hindi implementation activities for the year 1999-2000.

RESEARCH ACHIEVEMENTS

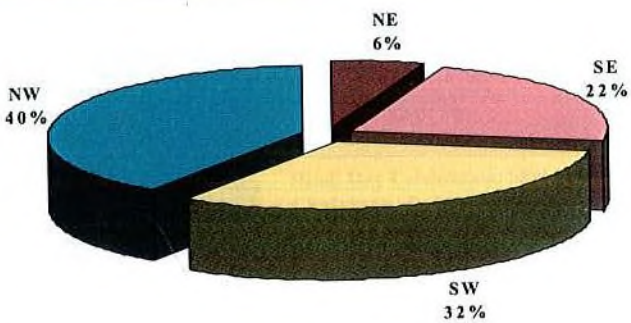
FISHERY RESOURCES ASSESSMENT DIVISION

The Division is responsible for monitoring the landings of exploited resources and developing models and methodologies for fish stock assessment and fishery forecasting.

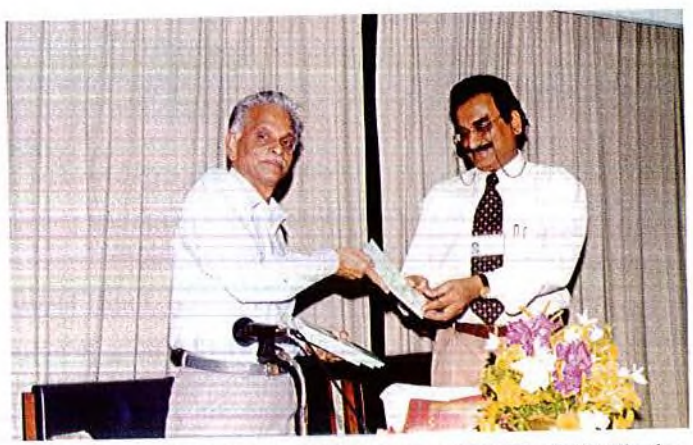
PROJECT CODE	**FSS/FRA/1.1**
PROJECT TITLE	**Assessment of exploited marine fishery resources**
SCIENTISTS	**K.N. Kurup,** K. Balan, M. Srinath, K. Vijayalakshmi, T.V. Sathianandan and Wilson T. Mathew
CENTRES	Cochin

The data generated under this project form the input data for research projects of the Institute in the capture sector. The salient findings are:

- The marine fish production in India during 2000 has been provisionally estimated at 2.70 million tonnes which is about 2,82,000 t (12%) more compared to 2.42 million tonnes of 1999.



Region-wise share in marine fish landing



Dr.K.Gopakumar, DDG (Fisheries)ICAR releasing CMFRI Special Publication, *"A code list of common marine living resources of the Indian Seas*

- The pelagics formed about 50.2% of the total landings and demersal finfish, crustaceans and molluscs together 49.8%.
- The landings by mechanised and traditional units accounted for 66% and 34% respectively (motorised 26% and non-motorised sector 8%).

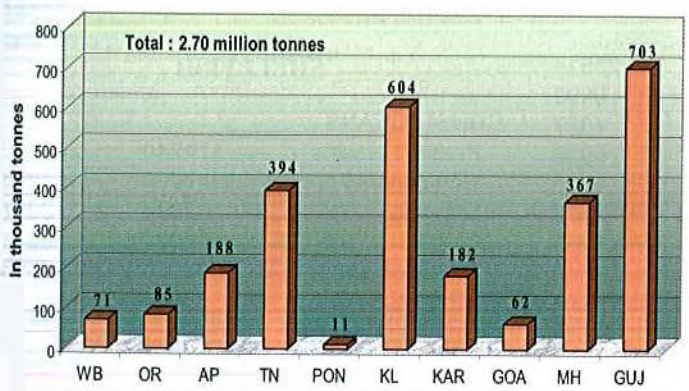
The features of the resourcewise landings in the country during 2000 compared to 1999 are:

- An increase of 52% (1,26,000 t) in the landings of oil sardine with an estimate of 3,67,000 t in 2000.
- An increase of 6,000 t (6%) in the catches of Bombay-duck with an estimated landing of 98,000 t.
- An increase of 35,000 t (20%) in the landings of perches, the estimate in 2000 being 2,14,000 t.
- An increase of 23,000 t (15%) in the landings of croakers in 2000, with an estimate of 1,81,000 t.
- An increase of 20% (35,000 t) in the penaeid prawn landings, the estimate being 2,07,000 t.
- An increase of 2% (3,000 t) in the landings of non-penaeid prawns with an estimate of 1,51,000 t in 2000.
- An increase of 19,000 t (21%) in the landings of cephalopods the estimate being 1,12,000 t in 2000.
- An increase of 58,000 t (47%) in the catches of ribbonfishes the estimate being 1,82,000 t.
- A decrease of 36% (75,000 t) in the mackerel landings with an estimate of 1,33,000 t in 2000.
- A decrease of 37% (46,000 t) in the catches of lesser sardines with an estimate of 78,000 t.

Region-wise marine fish landings (tonnes)*

Region	1999	2000
NE	1,13,885 (5.1)	1,55,905 (5.8)
SE	6,23,556 (27.7)	5,92,555 (22.2)
SW	7,92,335 (35.2)	8,47,580 (31.8)
NW	7,22,922 (32.1)	10,69,778 (40.1)

* Excluding islands



Marine fish landings in different States during 2000

Zonal workshops

Zonal workshops for the field staff working in different maritime zones were conducted at Calicut, Tuticorin, Mumbai and Visakhapatnam Research Centres during February — March 2001. The workshops dealt with the review of the work on data collection, updating the sampling frame wherever required and refresher training course on identification of the exploited species.

Estimated landings (t) of Marine Fish during 1999 and 2000

PELAGIC FINFISH

Name of fish	1999	2000
CLUPEOIDS		
Wolf herring	14341	12899
Oil sardine	240957	367187
Other sardines	127042	80686
Hilsa shad	10012	10746
Other shads	11074	11835
Coilia	31169	36911
Setipinna	2321	4601
Stolephorus	49541	45534
Thrissina	10	31
Thryssa	31544	30904
Other clupeoids	48269	45672
BOMBAY-DUCK	94210	97548
HALF BEAKS & FULL BEAKS	5634	7316
FLYING FISHES	1798	2377
RIBBON FISHES	124702	182386
CARANGIDS		
Horse Mackerel	32679	22179
Scads	32851	25584
Leather-jackets	5646	7287
Other carangids	55275	55684
MACKERELS		
Indian mackerel	209733	134556
Other mackerels	0	0
SEER FISHES		
S. commerson	31089	36484
S. guttatus	13791	13755
S. lineolatus	130	54
Acanthocybium spp.	30	82
TUNAS		
E. affinis	22811	23514
Auxis. spp	8256	9090
K. pelamis	1840	4387
T. tonggol	9098	9935
Other tunas	6520	7075
BILL FISHES	2931	3570
BARRACUDAS	14315	18299
MULLETS	6605	6546
UNICORN COD	314	492
MISCELLANEOUS	47374	53242
TOTAL	**1293913**	**1368449**

DEMERSAL FINFISH

Name of fish	1999	2000
ELASMOBRANCHS		
Sharks	41512	48525
Skates	2712	2627
Rays	21678	21811
EELS	11381	9187
CATFISHES	47131	58332
LIZARD FISHES	17706	26714
PERCHES		
Rock cods	15153	24876
Snappers	6452	6268
Pig face breams	11301	11110
Threadfin breams	74069	116680
Other perches	38082	57282
GOATFISHES	20554	15627
THREADFINS	7816	9195
CROAKERS	167544	180723
SILVERBELLIES	53511	49384
WHITEFISH	4944	6179
POMFRETS		
Black pomfret	10302	12680
Silver pomfret	23210	24637
Chinese pomfret	906	854
FLAT FISHES		
Halibut	1138	1724
Flounders	104	171
Soles	45392	50275
MISCELLANEOUS	23662	30266
TOTAL	**646260**	**765127**

SHELLFISH

CRUSTACEANS		
Penaeid prawns	174340	207080
Non-penaeid prawns	147908	151288
Lobsters	2094	2387
Crabs	27689	48384
Stomatopods	49910	46005
MOLLUSCS		
Cephalopods	92377	111544
TOTAL	**494318**	**566688**

Grand Total	**2434491**	**2700264**

PROJECT CODE	**FSS/FRA/ST.1**
PROJECT TITLE	**Management Information System in Marine Fisheries**
SCIENTISTS	**K. Balan,** K.N. Kurup, M. Srinath, K. Vijayalakshmi, T.V. Sathianandan and Wilson T. Mathew
CENTRES	Cochin

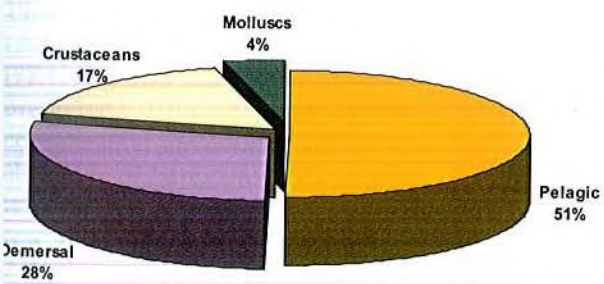
- The data on the exploited marine fishery resources have been computerized, processed and results stored on devices such as magnetic tapes/CD etc. for use by Scientists of this Institute.
- The LAN facility has been fully extended to all the Scientists/Technical personnel at the headquarters.
- A suite of application programs needed for the Management Information System was also developed.

Inauguration of ARIS cell by Dr. K. Gopakumar, Deputy Director General (Fisheries) ICAR

Marine Fishery Data Retrieval System

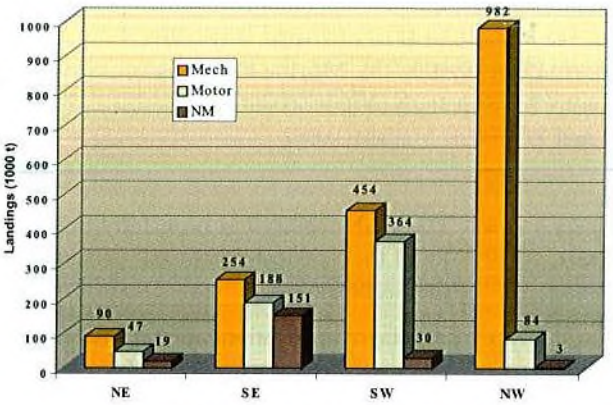
- A windows-based user-friendly query program, Marine Fishery Data Retrieval System (MFDRS) has been developed in Visual Basic.
- A large database ('MFDB6199') is developed using MS-Access and stored on the server.

PROJECT CODE	**FSS/FRA/1.3**
PROJECT TITLE	**Stock assessment techniques in marine fish and shellfish resources and management**
SCIENTISTS	**M. Srinath** and K.N. Kurup
CENTRES	Cochin



Assemblage-wise distribution of landings, 2000

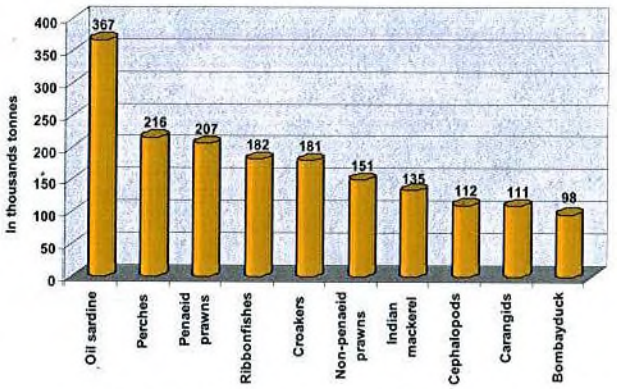
- A macro analysis was carried out by analysing the production trends by regions and by considering the region - resource combinations to assess the status of the resources on the basis of a generalised fishery development model . The estimated marine fish landings during 1961-'98 formed the database of the study. The estimates of potential yields based on the expected maximum yields and average long-term yields were obtained from the



Sector-wise landings in different regions

time series of the landings and also from an empirical model.

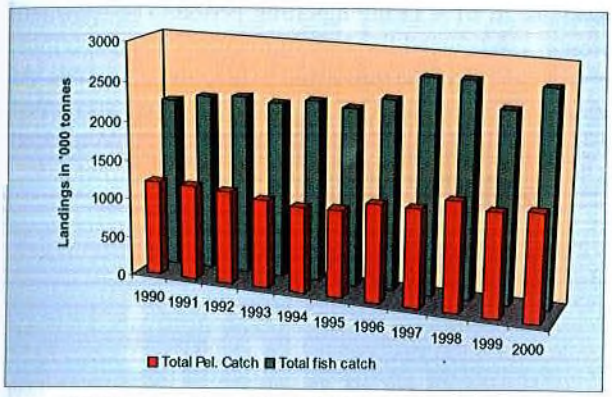
- Results reveal that about 40% of the resources are in either mature or senescent stage, suggesting that increased landings of these resources are unlikely.
- The aggregated demersal fish landings in most of the regions had leveled off. Gains are expected mainly from the pelagic stocks, the crustaceans and cephalopods.
- The estimated potential yield in terms of the expected maximum yields and the average long term yield were in the range of 3.0 to 3.3 million tonnes and 2.6 to 2.7 million tonnes respectively. The projected landings for 2005 ranged from 3.1 to 3.3 million tonnes and the pessimistic projections are in the range of 2.9 to 3.0 million tonnes.



Estimated landings of major groups - 2000

PELAGIC FISHERIES DIVISION

The Pelagic Fisheries Division implemented eight Institute Research Projects, two A.P Cess Fund Projects and one NATP Project. Data on fishery and biological aspects of 32 commercially exploited species were collected and analysed during the year for understanding the dynamics of the exploited stocks.



Total marine fish and pelagic fish landings in India during 1990-2000

Pelagic finfish production during 1985-2000 fluctuated between 0.78 million tonnes (mt) in 1985 and 1.35 m t in 2000 forming 50 % of the total marine fish production. A stagnation in the pelagic catch around 1.3 mt per annum against an annual potential yield of 2.21 m t of pelagic resources from the Indian EEZ, was observed in the last 10 years. About 68.1% of the production of pelagics in 2000 was obtained from the west coast, 30.1% from the east coast and the rest (1.8%) from the Island Territories. Among the maritime states, Kerala ranked first contributing 28.7% of the total pelagics, followed by Gujarat 16.8%, Tamilnadu 16.1%, Maharashtra 11.9%,Andhra Pradesh 8.1%, Karnataka 7.3% and Goa 3.3%.

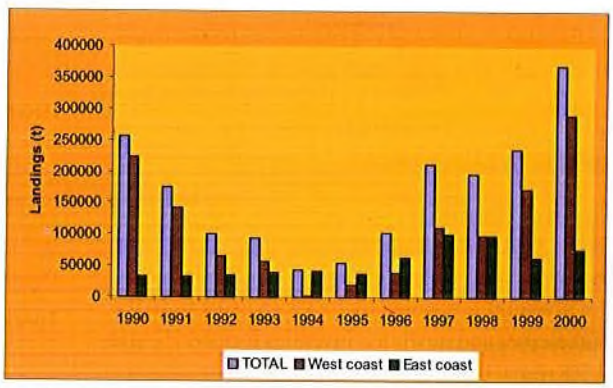
PROJECT CODE **PF/RE/1.1**

PROJECT TITLE **Fishery and resource characteristics of sardines (*Sardinella* spp.)**

SCIENTISTS **N.G.K.Pillai,** A.A.Jayaprakash, T.M.Yohannan, A.K.V. Nasser and E.M.Abdussamad

CENTRES Karwar, Mangalore, Calicut, Cochin, Tuticorin, Mandapam, Vishakapatnam

Oil sardine landings reached an all time peak of 3.68 lakh t during the year surpassing the production of 3 lakh t in 1968. The west coast contributed 79% (2,91,207 t) and the east coast 21% (77,191 t). This pattern in increase was predicted. However, taking into consideration the decadal variation in abundance of the resource, the production is expected to decrease in the immediate few years ahead. Kerala contributed 2,41,411 t (65.5%), followed by Tamilnadu 52,624 t (14.3%), Karnataka



Oil sardine landings along the Indian coast during 1990-2000

33,015 t (8.9%), Andhra Pradesh 19,120 t (5.2%) and Maharashtra 12,660 t (3.4%).

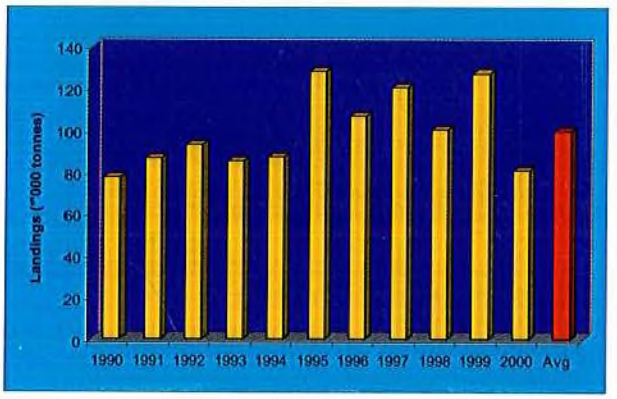
Oil sardine production in India varied from 0.47 lakh t in 1994 to 3.68 lakh t in 2000. Along the west coast the catches dwindled from 1.43 lakh t in 1991 to 0.03 lakh t in 1994. On the other hand fishery production along the east coast has been showing a steady increase from 1991 to 1997. The landings from both the coasts were nearly equal (over 1 lakh t each) during 1997 and 1998 and later the landings in the west coast showed an ascending trend to a peak during the current year. The area of peak exploitation continued to be the inshore waters of Kerala-Maharashtra stretch along the west coast, and the Mandapam-Rameswaram, Chennai-Visakhapatnam stretches along the east coast.

Characteristics of sardine resource at monitoring centres during the year 2000: The sardine catch increased by 8.5% at Kochi, 42.8% at Mangalore and 93% at Calicut. The production declined by 8% at Visakhapatnam, 66.8% at Mandapam and by 80% at Tuticorin. Oil sardine formed 75 to 100% of sardine catch along the west coast centres. At Chennai and Visakhapatnam also oil sardine dominated, forming 41% and 99% respectively. At Mandapam and Tuticorin, lesser sardines dominated the catch. The highest C/E of 1.2 t and 1.08 t was realised by the purseseines and the ringseines respectively at Kochi. The pair trawls and ringseines at Pamban landed 1766 t and 1231 t of oil sardine with a C/E of 3.5 and 7.8 t respectively during January to March period.

Exploitation of oil sardine juveniles: The juveniles (<100 mm) formed about 20% of the catch along the west coast. In the ringseines and similar gears, the juveniles amounted to 25.3% (53,614 t). In the purseseines and trawls the juveniles formed 1% and 0.5% respectively and along the east coast, juvenile catch was less than 1%.

Stock Assessment: Along the west coast the estimated MSY of oil sardine is 2.97 lakh t against the current average yield (1997-2000) of 2.91 lakh t. MSY along the east cost is estimated as 0.92 lakh t against the current average yield of 0.91 lakh t.

Spawning population: The percentage of spawning population of oil sardine in the landings at Kochi showed an increase from 13% in 1998 to 61% in the reporting period. The spawners accounted for 75% of the catch of purseseines, 78% in the trawls and 31% in the ringseines. At Karwar, Mangalore and Kozhikode it accounted for 26%, 63% and 30% respectively compared to 83% at Visakhapatnam and nil at Chennai.



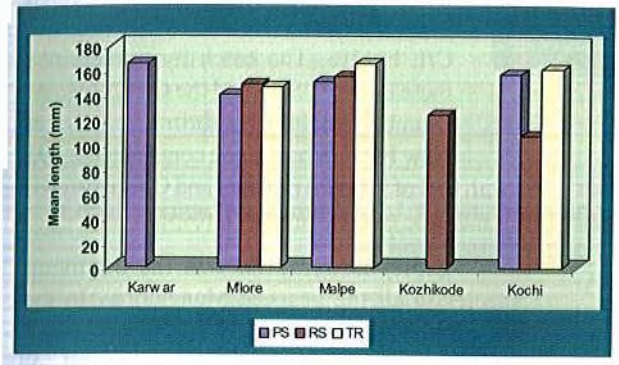
Landings of lesser sardines in India during 1990-2000

Recruitment: The recruitment of oil sardine extended from April to November. Along the east coast the recruitment took place during March to August with peak in May/June.

Beaching of oil sardine: Large quantities of live oil sardines were washed ashore during July at Uchila and Ullal beaches near Someshwara (20 km south of Mangalore); which was indicated to be caused by upwelling during the period.

Introduction of ringseines along southeast coast: For the first, time ringseines were introduced on an experimental basis along the

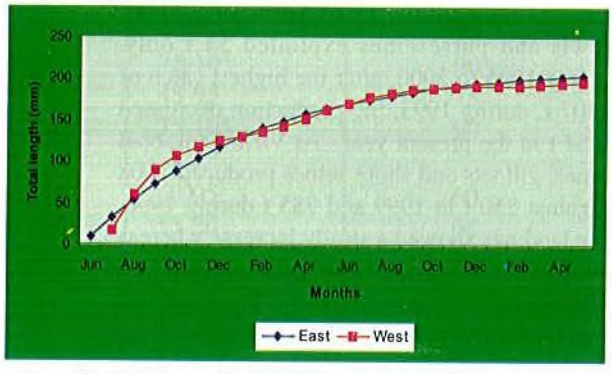
southeast coast at Pamban to exploit the resources such as sardines and other small pelagics. This was a measure to minimize the operational costs and to slowly replace the existing pair trawls that presently exploit such resources. The success has prompted many fishermen to switch over to ringseines.



Gearwise mean size of oil sardine at different landing centres

Lesser sardines: *Sardinella albella* and *S. gibbosa* mainly constituted the sardine catch at Mandapam. At Tuticorin, *S. gibbosa* was the dominant species followed by S. albella and *S. sirm*. Along the west coast, the lesser sardines were very poorly represented except at Mangalore where species such as *S. gibbosa*, *S. fimbriata* and *S. brachysoma* constituted a minor fishery. The lesser sardine landings at Visakhapatnam of *S. fimbriata* and *S. gibbosa* and at Chennai, of *S. gibbosa*.

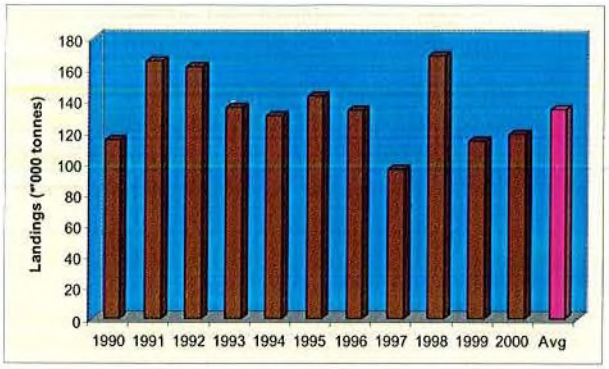
Stock assessment of lesser sardines: The average landings of lesser sardines during 1995-99 was 1.17 lakh t, out of which 0.76 lakh t (64.5%) was from the east coast and the rest 0.42 lakh t from west coast. Along the east coast the resource exploitation is at MSY level, and the present yield and the MSY in parenthesis for respective species are: *S. gibbosa* 35,340 t (35,570t), *S. sirm* 6,421 t (6,623 t), *S. fimbriata* 21,680 t (21,986 t) and *S. albella* 7,949 t (7,950 t); on west coast: *S. gibbosa* 36,051 t (40,517 t) and *S. fimbriata* 21,680 t (25,209t). The total all India production of lesser sardines has stabilised around 1 and 1.2 lakh t during 1995-1999 compared to around 0.87 lakh t during the early 90s.



Seasonally oscillating growth curve of oil sardine along the Indian coast

PROJECT CODE PF/RE/1.2
PROJECT TITLE **Fishery and resource characteristics of anchovies**
SCIENTISTS **R. Thiagarajan,** M. Zaffar Khan, Prathibha Rohit, A.A. Jayaprakash and H. Mohammed Kasim
CENTRES Mumbai, Mangalore, Cochin, Vizhinjam, Mandapam, Chennai, and Kakinada

During the last one and a half decades, the anchovies recorded the highest production of 1.65 lakh t in 1991, but later showed a declining trend. During the year 2000, the production was 1.2 lakh t which formed 8.7% of the total marine fish production. State wise, the highest contribution of 25,643 t was from Kerala followed by 24,828 t from Gujarat and 18,391 t from Tamilnadu.



Landings of anchovies in India

Fishery: At Mumbai, the landings of anchovies by shrimp trawlers improved to 3331 t against 2781 t of the previous year, at a C/E of 119 kg/ trawl unit, forming 4.7% of total landings. At Mangalore and Malpe, the landings declined from 6225 t in 1998 to 5213 t in 1999 and 5198 t in 2000, and were contributed equally by purseseiners and trawlers. At Kochi, ring seines, trawls and purseseines exploited 54 t only. During 1995 to 2000, after the highest catch of 1,307 t. during 1993, the production decreased to 54 t in the present year. At Vizhinjam, boat seines, gillnets and shore seines produced 1008 t against 250 t in 1999 and 785 t during 1998. The landings showed a steady increase whereas the mechanised fishery at other centres showed a declining or a steady trend. The probable reasons for the poor landings of anchovies are 1) changes in the trawling ground to more offshore areas, 2) stay fishing by the trawlers where most of the low quality by - catch like anchovies were thrown overboard due to lack of storing space, and 3) the purseiners are not operating small mesh nets and mostly targeting other pelagic fishes like sardines and mackerel.

Along the east coast, at Kakinada the landings by trawlers declined to 706 t from 779 t in 1999 and 2,459 t in 1998. At Rameswaram, only 10 t of anchovies were landed by shrimp trawls with a C/E of 0.1 kg. At Chennai (Kasimedu) 232 t of anchovies landed by trawlers formed 2.5% of total catch.

At Mangalore, increased C/E was observed both in the purseseine and ringseines. The increase in the C/E in the respective gears were 15 and 175%. The trawl nets registered a decline in the catch (18%) and C/E (26%). At Malpe, the catch recorded an overall decrease of 21% as compared to the previous year. The catch in the trawlers decreased by 21% and the C/E by 4%. The catch by purseseines increased by 250% and the C/E 266%. At Mumbai landings by shrimp trawlers at New Ferry Wharf alone contributed 2,791 t with C/E of 90 kg. The catch and C/E registered an increase of 63% and 46% respectively.

Stolephorus devisi was the dominant species in all the gears at Mangalore. In the purseseines, the species formed 69% followed by *S. bataviensis* (11%), S. *macrops* and *S. buccaneeri* formed the rest. In trawls at Mangalore and Malpe *S. devisi* constituted 84% and 86% respectively. *S. bataviensis* formed 16% at the former centre and 14% at the latter centre. *S. devisi* was the dominant species in the trawls (74%), ring seines (95%) and purseseine (88%) at Kochi. At Kakinada, *S. bataviensis* (33%) was followed *S. commersonii* (21%), *S. devisi* (19%) and *S. indicus* (7%) in the fishery. At Mumbai *Coilia dussumieri* constituted the main anchovy species.

Spawning Season: Along both the coasts, most of the anchovies indicated a spawning season extending from October to May with a peak during the post monsoon .

Population parameters: *S. commersonii* is exposed to high fishing pressure and *S. devisi* to optimum fishing pressure while both *S. bataviensis* and *S. indicus* are under fished by the Kakinada shrimp trawlers. In Kerala, the MSY of *S. commersonii* is 11,830 t, against the present yield of 11,103 t. The standing stock and total stock are 8,410 t and 25,825 t respectively. *S devisi* is underexploited with the MSY and the current yield being 14,770 t and

13,690 t respectively against a total stock of 27,610 t. *S. devisi* is exposed to optimum fishing pressure while *S .bataviensis* is under fished by the purseseines, trawls and other gears at Mangalore and Malpe.

Species	L∞ (mm)	K (annual)	Mortality rates			Exploitation rate (E)
			Total (Z)	Fishing (F)	Natural (M)	
S.bataviensis	142	2.00	4.09	0.60	3.49	0.15
S.commersonii	165	1.40	9.56	6.91	2.65	0.72
S devisi	105	2.55	9.15	4.70	4.45	0.51
S. indicus	180	1.95	6.15	2.94	3.21	0.48

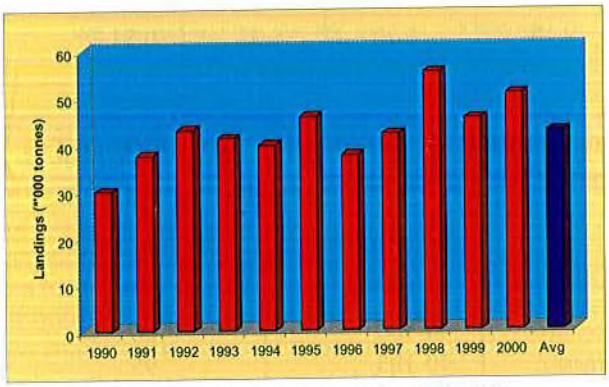
Length range (mm) and modal length (mm) of dominant species of anchovies landed by various gears at monitoring centres

Centre	Gear	Species	Length range	Modal length
Mumbai	TN	*Coilia dussumieri*	65-200	140
Mangalore	TN	*S. devisi*	40-100	80
	TN	*S. bataviensis*	40-105	95
	TN	*S. buccaneeri*	75-105	90
	PS	*S. devisi*	45-95	75
	PS	*S. buccaneeri*	75-105	90
Kochi	RS	*S. commersonii*	50-95	60
	RS	*S. macrops*	55-80	65
	TN	*S. devisi*	55-90	75
Kakinada	TN	*S. devisi*	45-95	75
	TN	*S. bataviensis*	25-145	85
	TN	*S. commersonii*	75-150	120
	TN	*S. indicus*	90-165	120
Chennai	TN	*S. indicus*	75-135	120
	TN	*S. devisi*	70-130	110
	TN	*S. bataviensis*	70-90	80
Mandapam	TN	*S. indicus*	75-135	120
Vizhinjam	SS	*S. devisi*	35-95	40
	BS	*S. devisi*	70-95	85

TN - Trawl net, RS - Ringseine, PS - Purseseine, SS - Shoreseine, BS - Boatseine

PROJECT CODE	**PF/RE/2.1**
PROJECT TITLE	**Investigations on the fishery and resource characteristics of seerfishes**
SCIENTISTS	**C. Muthiah,** A.K.V. Nasser, N.G.K. Pillai, U. Ganga, E.M. Abdussamad and H.Mohammed Kasim
CENTRES	Mangalore, Calicut, Cochin, Tuticorin, Chennai, and Vishakapatnam

Seerfish landings in India showed an increasing trend during the five decades since 1950 with the annual catch varying from 4,505 t in 1953 to an all time peak of 54,876 t in 1998. The average annual decadel catch during 1990-99 was 41,575 t compared to 7,278 t during the 1950-59 period. However, the rate of increase through successive decades has decreased indicating the attainment of asymptotic level of production. Overall the fishery during the year improved marginally (+ 5147 t, +11.3 %) compared to previous year, the estimated production during 2000 being 50,376 t which contributed 4% of the total pelagic species and 1.9 % of the total marine fish catch.

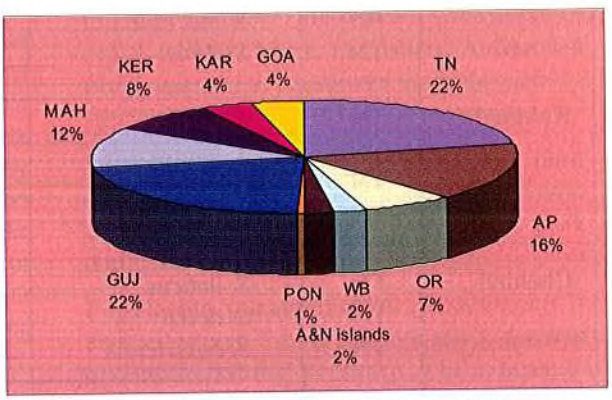


Seerfish landings in India during 1990-2000

During the 1950s, the east coast landed more seerfish (60%) than the west coast, which changed to 36: 64 during 1990s. During 1995-99, the species composition of the all-India seerfish catch was *S. commerson* (62.8%), *S. guttatus* (36.5%), *S. lineolatus* (0.6%) and, *Acanthocybium solandri* (0.1%). *S. commerson* dominated *S. guttatus* in the southwest coast (92%) and in the southeast coast the contribution was 76 and 22% respectively. *S. guttatus* was more abundant in the northeast coast (51%) and northwest coast (56 %). *S. lineolatus* and *A. solandri* were observed on the southeast coast.

Fishery: During 1995-99, on an all-India basis, gillnet accounted 64.8% (catch: 28,701 t, effort: 3.54 million units (boat days), catch rate: 8.1 kg/unit) followed by trawl 17.4% (7693 t; 31.985 million hours; 0.24 kg/hr), hook and line 4% (1,752 t, 0.477 million units, 3.7 kg unit) and the rest (13.9%) by other gears such as purse seines, shore seines, boat seines, longlines and trolling.

The estimated average annual catch during 1995-99 was 159 t at Visakhapatnam, 402 t at Kakinada, 561 t at Chennai, 621 t at Tuticorin, 353 t at Kochi, 69 t at Calicut, 916 t at Mangalore-Malpe and 1,321 t at Veraval. The seerfish fishery, as compared to last year showed a general decline in all centres except at Calicut



Contribution of maritime states (average 1995-99) to seerfish landings in India

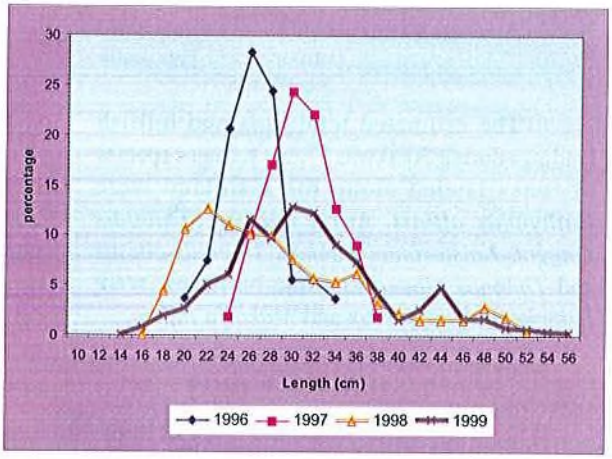
and Veraval where it showed appreciable improvement. As compared to the previous season, the catch decreased by 43.8% at Visakhapatnam, 54.6% at Kakinada, 54.7% at Chennai, 20% at Tuticorin, 58.0% at Kochi and 1.1% at Mangalore while, it increased by 55.8% at Calicut and 90.2% at Veraval.

Biology

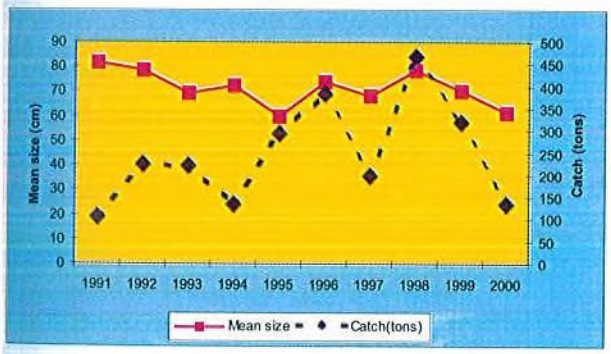
S. commerson: The length range and modal size of *S. commerson* in the large mesh size gillnets at some of the fishery centres was 32-114 cm (58 cm) at Mangalore, 22-110 cm (65 cm) at Chennai and 18-134 cm (94 cm) at Kakinada. The catches of seerfishes and the mean size are indicating a decreasing trend in drift gilll nets operated at Kochi in recent times.

In trawls, size range was 52-146 cm at Tuticorin, 20 -54 cm at Veraval and 16-84 cm at Mangalore. Catches of small sized fishes (40-56 cm) were reported during November at Kozhikode and also at Kochi (20-42 cm) by trawlers. The small meshed gillnet (*Podivalai*) operated at Tuticorin also landed fishes in the size range of 18-68 cm with size groups of 22-54 cm accounting for 93.5% of the catch. As this size range is below the length at first maturity reported for the species, certain regulations are required.

S. guttatus: The length range and modal size of *S. guttatus* in large meshed gillnets were 16-58 cm (42 cm) at Veraval, 26-58 cm (41 cm) at Mangalore, 12-68 cm (44 cm) at Kakinada and 12-51 cm (18 cm) at Visakhapatnam.



Annual length frequency distribution of *S.commerson* in trawl catches at Cochin during 1996-1999.



Variations in landings and mean size of *Scomberomorus commerson* in drift gillnet at Cochin Fisheries Harbour

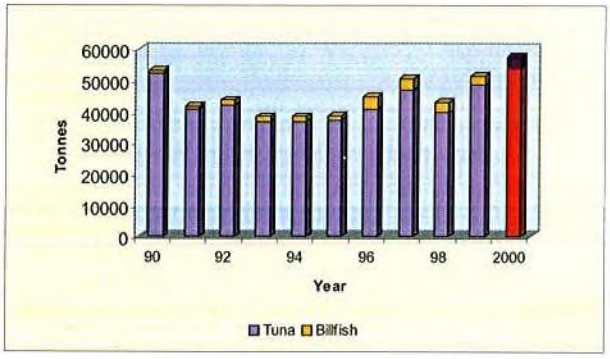
Exploitation rate of (E) *S. commerson* varied from 0.63 for gillnets at Veraval to 0.86 for trawl at Mangalore and from 0.77 for gillnet at Chennai and Kakinada to 0.89 for the small -meshed gillnet at Tuticorin. The E is estimated to be 0.75 and 0.76 respectively for the west and east coasts.

The exploitation rate (E) which can produce the maximum yield is estimated to be 0.5861 along the west coast, whereas the prevailing E is higher, being 0.69, indicating that *S. guttatus* is also exposed to high fishing pressure.

Based on the studies for the period 1995-99 the annual stock of *S. commerson* was estimated to be 14,072 t and 21,919 t for the east and west coast respectively and for *S.guttatus* 6,235 t and 15,229 t.

PROJECT CODE	**PF/RE/2.2**
PROJECT TITLE	**Investigations on the fishery and resource characteristics of tunas, tuna live-baits and billfishes**
SCIENTISTS	**P.P.Pillai,** M.Zaffar Khan, C .Muthiah, T.M.Yohannan, G.Gopakumar, N.G.K.Pillai, U.Ganga , M.Sivadas
CENTRES	H.Mohammed Kasim, and A.K.V.Nasser Veraval, Mumbai, Mangalore, Calicut, Cochin, Vizhinjam, Minicoy, Tuticorin and Kakinada

The estimated total tuna and billfish landings during 2000 was 57,604 t. Major species of tunas landed along the mainland were *Euthynnus affinis, Auxis thazard, Thunnus tonggol, Katsuwonus pelamis, Thunnus obesus* and *Thunnus albacares* while billfishes were *Istiophorus platypterus* and *Makaira indica.*

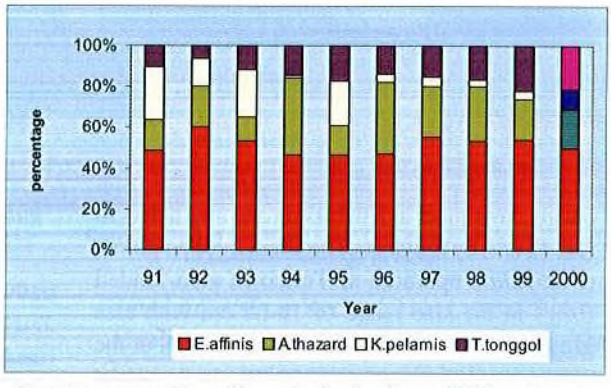


All India landings of tunas and billfishes

Fishery: During the year, as compared to the previous year, tuna landings increased in certain areas like Mangalore- Malpe region (+300%) and the Vizhinjam-Tuticorin belt (+29%). At Mumbai, Kochi, Kozhikode and Visakhapatnam catches showed a decline of 30-85%. Landing trends during the decade indicate that the catches of coastal species *E. affinis* and *A. thazard* have stabilized around 19,000 t and 7,500 t respectively since 1997. Catches of *T. albacares* and *T. tonggol* are showing an increasing trend, especially with many fishing fleets equipped to operate in distant waters. Catches of *K. pelamis* which were showing a declining trend since 1996 with average landings of 1354 t annually, showed an improvement in 2000, with an estimated 3076 t being landed along the mainland coast.

Drift gill net was the major gear employed in the fishery along the entire mainland coast in addition to hooks and line and purse seines. Purse seines were mainly employed at Mangalore, where the catch rate was 134 kg . Catch rates of tunas in gill nets along the west coast ranged between 10.4 kg and 144 kg while on the east coast it was 10.9 kg and 106.4 kg. At Colachel (Kanyakumari district) and Tuticorin, medium sized trawlers (28-50 ft) operated at a depth range of 250 – 350 m using troll lines during March –April period targeting mainly yellowfin tunas.

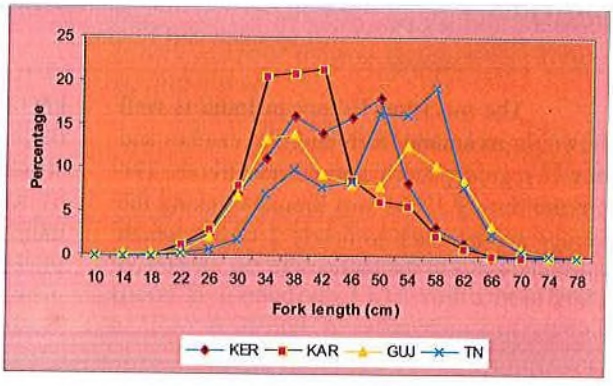
Biology: Along the mainland, the size range of *Euthynnus affinis* in the fishery was



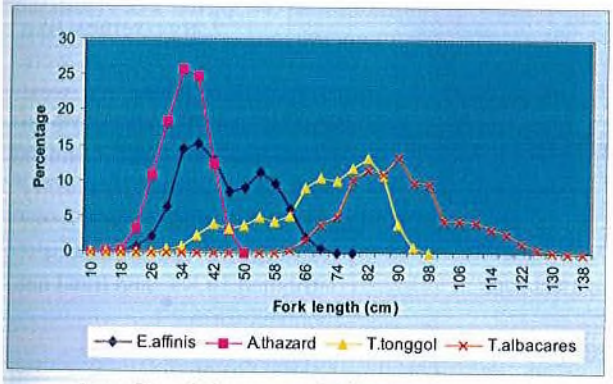
Species composition of tunas in the landings of different years

10-78 cm, *Auxis thazard* 16-48 cm, *Thunnus tonggol* 30-98 cm and *Thunnus albacares* 58-138 cm with the major groups contributing to the fishery being 34-56 cm, 28-34 cm, 74-84cm and 84-98 cm respectively. Yellowfin tuna in the size range 86-147 cm constituted about 71 % of the catch in the seasonal trawl fishery of Colachel- Tuticorin belt. In *E. affinis* along the east coast half of the catch was in the size range (50-60 cm). Along the Karnataka coast, nearly 75 % of the catch is composed of size groups below 44 cm which is the size at first maturity (L_m) of the species. The length at first capture (L_c) of *A. thazard* is above the reported length at first maturity.

Growth parameter estimates and status of exploitation of different species analysed using all India catch and length frequency data during the 1989- '98 is given below :



Length frequency distribution of *E.affinis* along the coasts of some states



Annual length frequency distribution of tuna species

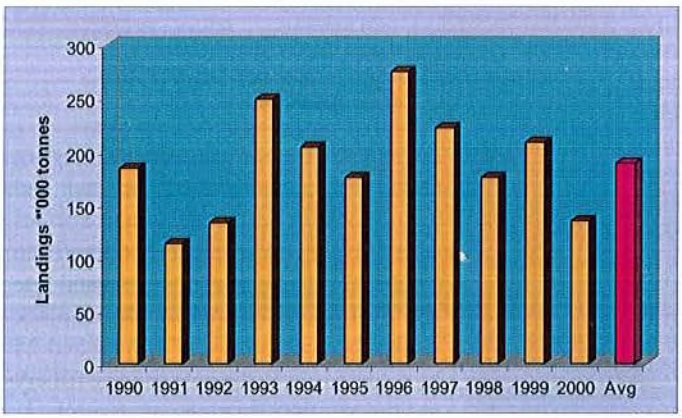
At Minicoy, during 2000, an estimated 509 tonnes of tuna was landed which showed a decline of 37.5% compared to previous year. The main cause of this was the absence of flotsam fishery this year, especially during October-December period. Skipjack and yellowfin tuna formed the main species with skipjack dominating the pole and line catches (87%). At Minicoy, pole and line and troll line employed for the skipjack fishery had catch rates of 166 kg and 25 kg respectively. In the pole and line fishery at Minicoy, the size range of skipjack, *K. pelamis* was 28-74 cm and yellowfin, *T. albacares* 20-80 cm. Yellowfin above 60 cm size were rare and all the catch was constituted by immature tunas.

The composition of tuna live-bait catch was sprats (67%), apogonids (29%), and caesionids (4%) with the estimated annual catch being 8.4 t.

Species	L∞ (cm)	K (annual)	Z	F	M	E	L_c
E.affinis	89.0	0.9	5.85	4.90	0.98	0.8	44
A.thazard	54.0	0.87	4.40	3.20	1.20	0.7	35
T.albacares	172.0	0.39	3.10	2.50	0.60	0.8	104
T.tonggol	92.5	1.20	1.86	0.70	1.20	0.4	68

PROJECT CODE	**PF/RE/2.3**
PROJECT TITLE	**Investigations on the fishery and resource characteristics of mackerel**
SCIENTISTS	**T.M. Yohannan,** Prathibha Rohit, P.N. Radhakrishnan Nair, G.Gopakumar, E.M. Abdussamad and H.Mohammed Kasim
CENTRES	Veraval, Karwar, Mangalore, Calicut, Cochin, Vizhinjam, Tuticorin, Vishakapatnam and Kakinada

The mackerel fishery in India is well known for its annual fluctuations in catches and shows a regular pattern in its decadal trends. The increase during 1990s was dramatic taking the average annual catch to nearly 2 lakh t, which was mainly due to the increase in the efficiency of exploitation. During 1991-99 period, the annual catch fluctuated within a range of 1.13 to 2.74 lakh t, with a peak in 1993 (2.49 lakh t) and a higher peak in 1996 (2.74 lakh t). All these peaks were the result of fluctuations in the catch along the west coast. After 1992, when more than 60 thousand t of mackerel were caught along the east coast the catches were steadily on the decline.



All India landings of Mackerel during 1990-2000

Kerala continued to dominate in the mackerel fishery with a catch contribution of 38.7%. The contribution by Karnataka, which was the leading producer till 80's, was 16.9% followed by Maharashtra, Tamilnadu, Goa and Andhra Pradesh. The catch rate of mackerel per km of coastline and per 1000 square km area of the continental shelf was estimated and Goa stands first in catch per km of coastline followed by Kerala and Karnataka. However, the maximum catch per area of shelf was in Kerala followed by Goa and Karnataka. The trend of annual catch of mackerel during the 90s showed that maximum increase was in Kerala followed by Maharashtra and Karnataka and the maximum decline was in Goa followed by Tamilnadu.

Large seines like purseseines and ringseines were operated only along the west coast and contributed 62.3% of the total mackerel catch. Gillnets which were operated mainly along the east coast and to a lesser extent along the west coast contributed 18.8%, and trawl net accounted for 6.2%.

During 2000 the mackerel fishery along the west coast was supported by two year-classes, 1999-year class (A) and 2000-year class (B). The year class 'A' supported the fishery during the first half of the year, which was exploited mainly by trawls, operated in deeper waters. By August the recruitment of the year class 'B' started at an average size of 12.5 cm and it dominated the large seine fishery of the west coast till the end of the year. On an average, 44% of the catch in weight was comprised of the 'B' year class, which formed 51.4% of the catch in numbers with a mean length of 19.3 cm. The catch of 'A' was 56% in weight and 48.6% in numbers with a mean size of 21.1 cm. This

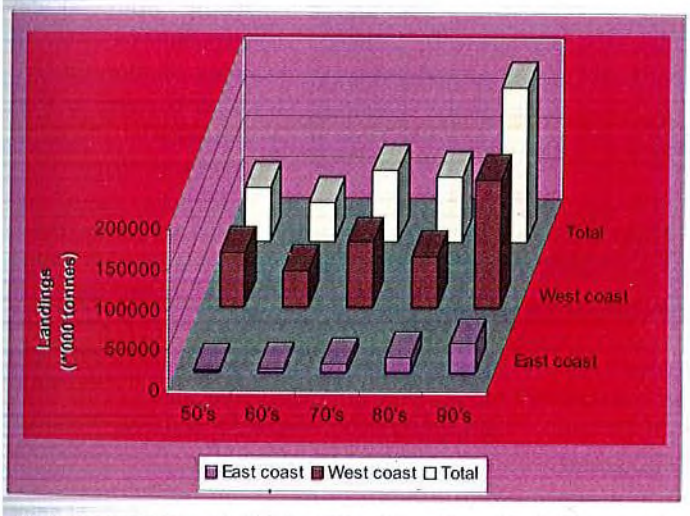
shows that the growth overfishing in the mackerel fishery is being contained. The total mortality (Z) of the year class 'B' was 5.13 with a fishing mortality (F) of 3 and exploitation rate (E) of 0.58. The Z of year class 'A' was only 2.81 with a F of 0.68 and E of 0.24.

The fishery for the two different year classes was totally different. The year class 'A' was mainly exploited by trawl in the first half of the year when mackerel ceases to form large shoals in the surface waters but lie diffused in the deeper waters. The year class 'B' along the west coast was more vulnerable to exploitation by large seines during the post-monsoon when they formed large shoals in the coastal surface waters. Hence the Z, F and E values of 'B' were quite large. This is the period of large scale recruitment and exploitation of mackerel. However, during this year the exploitation was comparatively low during the post-monsoon season as their abundance was below normally observed.

At Veraval where the major gear is trawl, the fishing was more intense in summer, with peak catches in April. At purseseine centres like Karwar, Mangalore and Kochi it is the post monsoon fishery on the new recruits with peak catches during September-November. At Kozhikode the post monsoon fishery was a failure and peak catches were in June by ring seines and it was mostly composed of spawners. Even in Tuticorin and Pamban peak catches were in September. In Vizhinjam where large seines or trawls are not operated and the post-monsoon fishery was poor, the peak landings were in April by drift gill net.

In Andhra Pradesh also two different broods – the brood that originated in 1999 'A' and the current year's recruits 'B' – supported the fishery. 86.9% of the catch was contributed by brood 'A' with a mean length of 20.3 cm. Brood 'B' formed only 13.1% with a mean length of 15.8 cm. Brood 'A' suffered an Z of 6 with F of 4 and E of 0.67. Brood 'B' was a mixture of different broods haphazardly recruited during this year and hence the mortality estimates were not possible. The new recruits along the Andhra Pradesh coast were caught earlier than those along the west coast and peak catches were during January-March period.

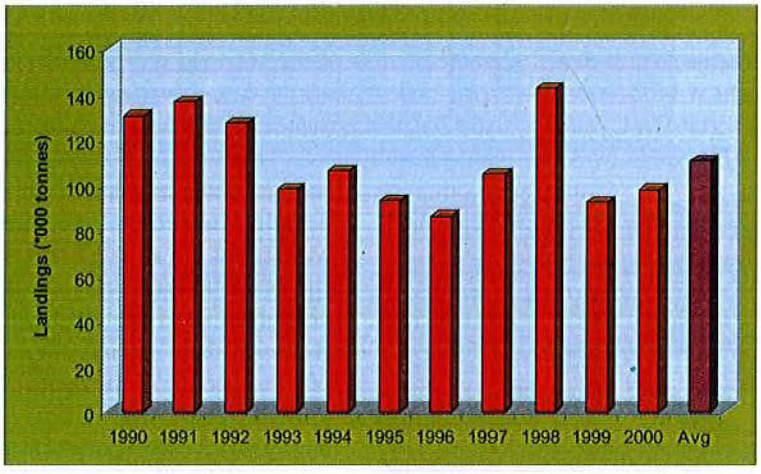
In general, the fishery depended mainly on the recruits of the previous year which was more evident along the east coast than the west. All along the coast the current year's recruitment was generally poor. The surge in the mackerel catches observed during this decade consequent to the widespread use of large seines and powerful outboard engines do not seem to sustain long. However, there are indications of a fast decline of the rampant growth overfishing witnessed during this decade. It is not clear whether this is due to the unfavorable environmental conditions, which prevailed during the early period of recruitment or due to a conscious reduced fishing effort.



Decadal variations in Mackerel landings along the Indian coast

PROJECT CODE	**PF/RE/ 3**
PROJECT TITLE	**Investigations on the fishery and resource characteristics of Bombay-duck**
SCIENTISTS	**Alexander Kurian**
CENTRES	Veraval, Mumbai

The total all India Bombay-duck landings during the decade fluctuated between 85, 766 t (1996) and 136, 450 t (1991) with an estimated landing of 97,548 t in 2000. The fishery shows a declining trend with catches fluctuating around 1 lakh t annually for the past decade. During 2000, Gujarat state accounted for the major portion of the landings (70,078 t), followed by Maharashtra, which contributed 17,614 t (18.1%). It has also emerged as a resource along the north east coast. West Bengal which accounted for 8686 t (88% of the east coast catches) was followed by Andhra Pradesh (691t, 7%) and Orissa (477 t, 5%).



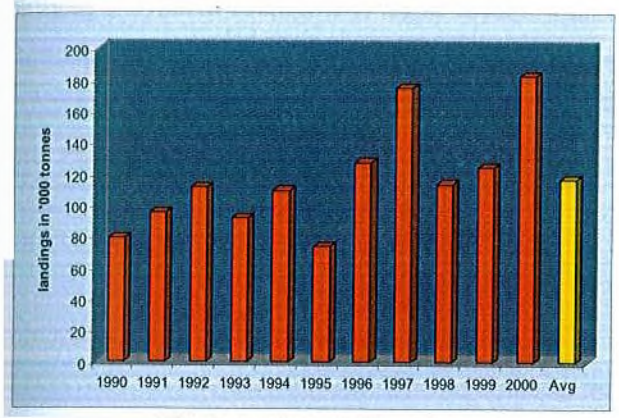
All India landings of Bombay-duck during 1990-2000

The fishery along the northwest coast has witnessed an increase in effort (98%), decrease in the artisanal catches (20%) and decrease in Bombay-duck catches (14%) during this year as compared to the previous season. Bombay-duck landings in the *dol* net fishery along the Mumbai coast were estimated at 2854 t during 2000. The landings did not show any significant increase compared to last year with catches having stabilized around 2800 t and effort at 50,000 hauls. *Dol* net catch of Gujarat state was estimated at 70,078 t with a CPUE of 107 kg/ haul. Compared to the previous season, the catch and CPUE has declined by 4 and 22% respectively. The landings occurred throughout the year with maximum landings during the IV quarter (Oct- Dec) and I (Jan –Mar) of the year.

The average length at recruitment to the fishery along the north west coast was observed to be at 53 mm at an age of 0.28 years. Size of Bombay duck caught were in the range of 30- 330 mm with size groups upto 20 cm accounting for 77 %. An index of reproductive stress (Length at first maturity (L_m)/ asymptotic length (L_∞) indicated a value of 0.63 and 0.58 during 1999-2000 and 2000-2001 respectively which is considered to be high. It has also been noted that during 1999 –2000 four broods have originated compared to only three during 2000-2001 indicating a possible reduction of catch in the coming season.

PROJECT CODE	**PF/RE/4**
PROJECT TITLE	**Investigations on the fishery and resource characteristics of ribbonfishes**
SCIENTISTS	**P.N.Radhakrishnan Nair,** M.Zaffar Khan, C.Muthiah, R.Thiagarajan and H.Mohammed Kasim
CENTRES	Veraval, Mumbai, Karwar, Mangalore, Cochin, Vizhinjam, Chennai, Kakinada and Visakhapatnam

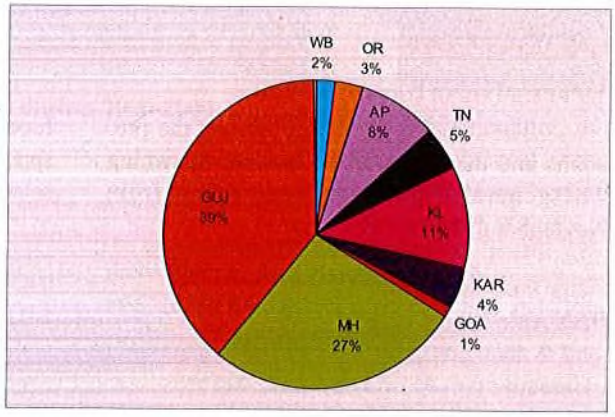
The annual ribbonfish production in India during the last decade (1991-2000) exhibited an increasing trend with large inter annual variations. The landings were in its peak in 2000 (1.8 lakh t) and lowest in 1995. About 82% of the landings was obtained from the west coast while the east coast contribution was only18%. The ribbonfish landings during 2000 was very high compared to the previous year in almost all the states except Andhra Pradesh where a slight decline by 7100t (35%) was noticed. In other states the increase was to the tune of 16.5% in Kerala to 346.6% in Karnataka. On the national level an increase of 46.7% was discernible during the year. Trawl net was the dominant gear in the fishery contributing 94% to the annual landings and the traditional gears like gill nets and boat seine landed only 6%.



All India landings of ribbonfishes

The fishery was predominant in the 4th quarter (October-December) of the year in Gujarat, Maharashtra and Karnataka. In Kerala it was maximum in the 3rd quarter (July-September) while in Andhra Pradesh it was in the 1st quarter (January-March). In Tamil nadu peaks were noticed in 4th and 1st quarters, contributing 35% each. Generally the fishery was in its peak during the post-monsoon followed by the pre-monsoon period excepting in Kerala where it was mostly a monsoon fishery.

Increased production of ribbon fish was reported from almost all the centres of observation except at Kochi where the catch declined by 33%. In other centres the reported increase was 40.3% at Veraval, 61.1% at Mumbai, 102.2% at Karwar-Tadri, 372.3% at Mangalore-Malpe, 3.9% at Chennai, 36.4% at Kakinada and 926.5% at



Contribution of maritime states (average of 1991-2000) to ribbonfish landings

Visakhapatnam. At Mumbai, Chennai and Kakinada increased landings of ribbonfish were observed. A slight decline in CPUE of trawl was noticeable only at Kochi and in all other centers it increased considerably. All these indicate that the ribbonfish resource was abundant during the year all along the coast of India resulting in an increase in production. Having a good export market, ribbonfish is a target group and its abundance in the fishing grounds had attracted more number of units resulting in an increase in effort and in landings in most of the centers. This is much more evident in the case of boat seine (57%) at Vizhinjam, trawling hours at Visakhapatnam (120.4%), trawl net at Veraval (3.9%), Tadri (6.4%) and Mangalore-Malpe (13.9%).

Trichiurus lepturus was the dominant species in all the centers and constituted 98.5% in the total catch. The rest was constituted by T. russelli (0.4%), *Lepturacanthus gangeticus* (0.2%), *L .savala* a (0.5%) and *Eupleuro grammus muticus* (0.4%).

The size distribution, common size and mean length of *T. lepturus* in different gears at various centres is given below:

Centre	Gear	Length range (cm)	Common size (cm) & percent	Mean length (cm)
Veraval	Trawl Gill net	20-130 48-132	50-80 (74%) 76-114 (80%)	63 97
Mangalore-Malpe	Trawl	30-110	42-84 (89%)	64
Kochi	Trawl	40-101	68-82 (55%)	79
Chennai	Trawl	20-100	35-55 (80%)	48
Kakinada	Trawl	18-104	34-54 (70%)	50
Visakhapatnam	Trawl Boatseine	24-82 20-84	38-56 (80%) 30-54 (67%)	48 45

The females dominated among the pre-adults and the adults of *T. lepturus*. Spawning was generally prolonged extending from November to June.

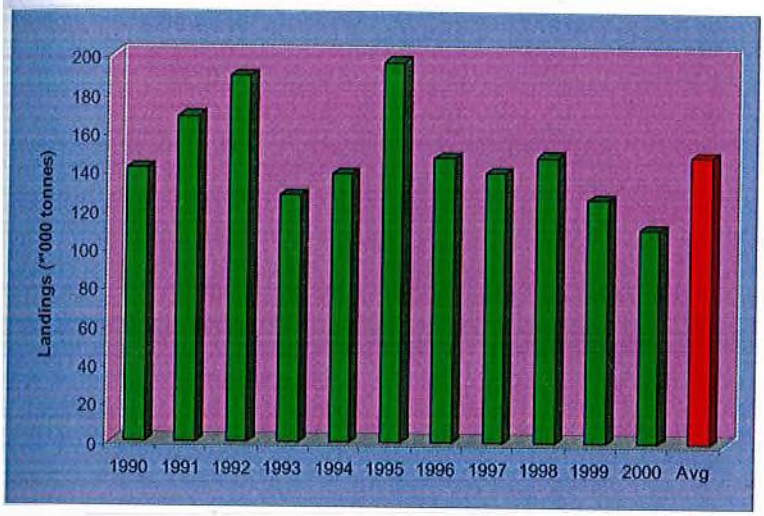
T. lepturus is purely a carnivore feeding on fishes and also crustaceans and squid. The food fishes are mainly anchovies, *Decapterus* spp., *Saurida* spp. silver bellies, *Nemipterus* spp., sciaenids, *Thryssa*, etc.

The stock assessment studies were conducted at Mangalore, Kochi and Kakinada. The growth and mortality parameters were estimated. The estimates are:

Centres	$L\infty$ (cm)	K /Yr	Z	M	F	E
Kochi	127.0	0.72	4.05	0.98	4.01	0.82
Mangalore	121.0	0.65	3.87	0.92	2.95	0.76
Kakinada	111.5	1.75	5.12	1.80	3.30	0.65

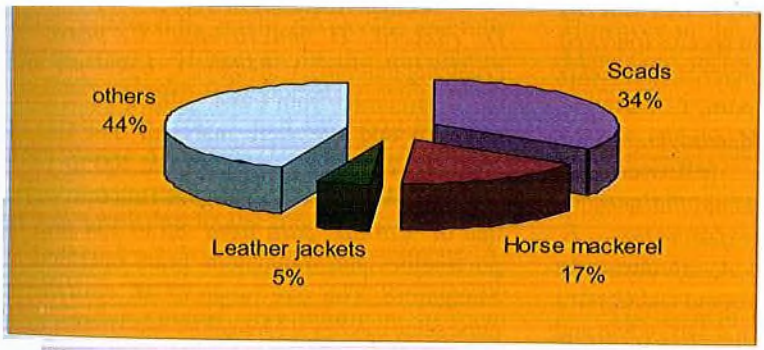
PROJECT CODE	**PF/RE/5**
PROJECT TITLE	**Investigations on the fishery and resource characteristics of carangids**
SCIENTISTS	**H. Mohammed Kasim,** Prathibha Rohit, P.N. Radhakrishnan Nair, R. Thiagarajan and E.M. Abdussamad
CENTRES	Veraval, Mangalore, Cochin, Vizhinjam, Tuticorin and Kakinada

During the decade, all India carangid landings fluctuated between 110,715 t (2000) and 189,737t (1992) with the catch trends indicating a stabilization of the yield around 140,000 t annually. During 1996-99 period, carangids were the third major pelagic resource with an estimated average landing of 140,231 t, constituting 5.5% of the total fish production. During 2000, an estimated 110,715 t was landed which formed 4% of the total marine fish landings. During 1998-2000, there was a fourfold increase in carangid landings at Veraval on the north west coast, but a declining trend was observed at Mangalore and Kochi centres on the south west coast. The landings showed fluctuations at centres like Tuticorin and Kakinada along the east coast.



All India landings of carangids during 1990-2000

Trawl contributed to the bulk of the carangid landings and during 2000 the contribution varied from 54.3% at Kochi to 98.5% at Kakinada. Other important gears were purseseine, drift gillnet and hook & line. The changes in catch, effort and catch rates during the current year at various fishery centres as compared to the previous year are given in the table.



Proportion of different groups of carangids in the landings in 2000

Gearwise/Centrewise fishery trends of carangids during 2000 compared to 1999

	Catch (% +/-)	Effort (% +/-)	Catch rate (% +/-)
Veraval			
Trawl	+ 55.7	+ 3.9	+ 49.9
Gillnet	+ 44.1	+ 9.0	+ 32.1
Mangalore			
Trawl	- 0.21	+ 13.9	- 12.4
Gillnet	- 18.6	- 3.5	- 15.8
Purseseine	- 72.7	+ 4.6	- 7.4
Kochi			
Trawl	- 51.9	+ 3.5	- 49.9
Gillnet	+ 1.7	+ 4.8	- 1.9
Ring seine	- 96.3	+ 1.6	- 94.8
Purse seine	+ 10.0	- 71	+ 39.3
Tuticorin			
Trawl net	+ 14.4	+ 3.5	+ 10.6
Large mesh	+ 34.4	+ 17.9	+ 14.0
Gillnet (*Paruvalai*)	- 18.2	+ 17.0	- 30.3
Small mesh			
GN (*Podivalai*)	+ 28.5	- 21.8	+ 64.6
Hooks and lines			
Kakinada			
Trawl	+ 50	- 6.0	+ 59.0
Gillnet	- 45	- 44.0	- 2.0

In the trawl landings, *Decapterus russelli* was the most dominant species followed by *Megalaspis cordyla, D. macrosoma, Selar crumenophthalmus, Caranx para, C. carangus* and *C. leptolepis.* In gillnets *M. cordyla*, was the most dominant species followed by *Scomberoides* spp., *S. crumenopthalmus, C. gymnostethoides, C. sexfasciatus, E. bipinnulatus, S. tala* and *A. djedaba.* In purseseine landings, *D. macrosoma* and *C. para* were dominant at Mangalore and *M. cordyla* and *A. djedaba* at Kochi.

Length frequency of 8 species (*M. cordyla D. russelli, D. macrosoma, C. para, S. crumenopthalmus, A. djedaba, C. leptolepis,* and *C. sexfasciatus)* from trawl, gillnet, purseseine and hook and line, were analysed. The size of *Caranx sexfasciatus* ranged from 400 to 1259 mm in hooks and line landings at Tuticorin while that of *Caranx para* from 85 to 134 mm in purseseines and indigenous gears operated at Mangalore. The size range of *M. cordyla* in purseseine catches at Mangalore was smaller than those observed in trawl and gillnet catches, consisting only 215 to 274 mm size groups.

Centrewise size range for various carangid species in the trawl and gillnet landings

Species/Centre	Trawl Size range (mm)	Gill net Size range (mm)
Megalaspis cordyla		
Veraval	210-479	210-519
Mangalore	165-409	240-469
Kochi	200-369	230-329
Kakinada	60-229	60-669
Caranx para		
Mangalore	85-164	85-134
Decapterus russelli		
Mangalore	70-234	
Kochi	120-239	
Kakinada	105-199	
Decapterus macrosoma		
Mangalore	180-224	
Kochi	175-239	
Kakinada	110-204	
Selar crumenophthalmus		
Kochi	140-299	
Kakinada	105-264	
Alepes djedaba		
Kochi	175-309	245-304
C. leptolepis		
Tuticorin	60-189	

Along the Karnataka coast, in the trawler catches at Mangalore, males of *D. russelli* were dominant, with gonads mostly in partially spent stage, followed by gravid, developing and fully spent stages. However, in the purseseine landings, females were dominant, with gonads in developing, gravid, partially spent and fully spent stages .As regards *D. macrosoma* in trawler catches along Mangalore and Kakinada coasts, females with developing gonads were dominant, followed by gravid and spent specimens. At Kakinada, females of *S. crumenophthalmus* with developing gonads were dominant in trawl landings. With regards to landings of *Megalaspis cordyla,* in purseseine at Mangalore and also in gillnet at Malpe, females with developing gonads were dominant followed by spent specimens. However in the trawl and gillnet catches at Mangalore, males with developing gonads were dominant.

The food and feeding habits of *D. russelli, D. macrosoma, C. para* and *M. cordyla* have been studied in the Mangalore/Malpe area. In *D. russelli* and *M. cordyla* the food mainly consisted of fishes, squids and *Acetes.*

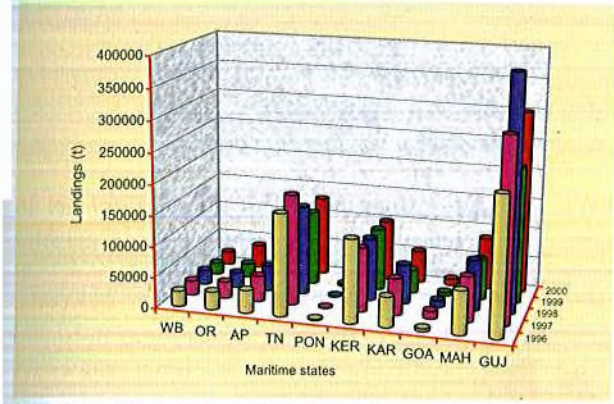
The growth parameters and exploitation status of 4 species at Kakinada and one species at Mangalore were estimated.

Estimates of population parameters and exploitation status of carangid species along Kakinada and Mangalore coasts during 2000

Species	L ∞ (cm)	K/yr	M	Z	F	E=F/Z
Kakinada						
D. russelli	21.55	1.40	2.46	6.61	4.15	0.63
D. macrosoma	22.00	2.05	3.14	5.95	2.81	0.47
S.crumenophthalmus	28.00	1.05	1.89	3.40	1.51	0.44
M. cordyla	71.00	1.40	1.76	4.26	2.50	0.59
Mangalore *C. para*	16.80	0.7	1.69	2.67	0.98	0.36

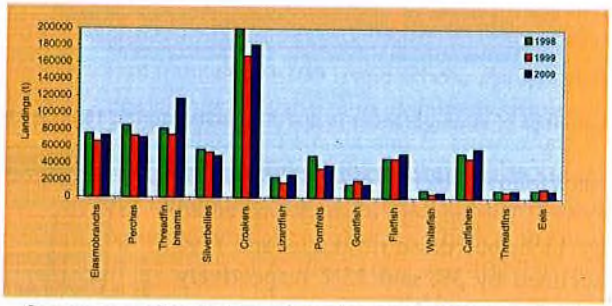
DEMERSAL FISHERIES DIVISION

The Demersal Fisheries Division continued research work on 8 approved research programmes. During the reporting year, about 7.6 lakh t of demersal finfish were landed along the country's coast, which formed about 28% of total marine fish landings in India. The landings increased by about 1,60,000 t over those of the previous year; this was mainly due to the increase of about 78,000 t in Gujarat, 19,000 t in Maharashtra and 15,000 t in Karnataka. Threadfin breams, croakers, lizardfish and catfish contributed significantly to the increased production. The required data on population characteristics were collected and analysed. A special effort was made during the year to analyse the data on the fishery of Lactarius lactarius, the landings of which have been showing declining trends.



Estimated landings of demersal fishes along the coasts of maritime states

Potential yield estimates of the demersal fish were made for the use of the Working Group on Revalidation of Potential Yield in the Indian EEZ constituted by the Govt. of India. The current yield of about 0.76 m t of demersal finfish was below the potential yield estimate of 1.2 m t, though certain resources were exploited almost at the level of their potential yield. Catfish showed improvement over the past two years mainly due to increased yield from Maharashtra, Tamilnadu and Orissa though the landings declined considerably in Kerala and Karnataka. The landings of Lactarius increased by 1,200 t during the year, which was brought about by the increase in yield in Maharashtra and Karnataka.



Groupwise estimated landings of demersal fishes in India during 1998-2000

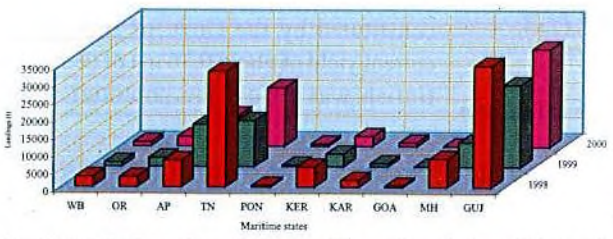
Dr.E.G. Silas, Chairman and Members of the Committee on Revalidation of Potential Yield in the Indian EEZ at a meeting in CMFRI

In finfish mariculture, the infrastructure for larval rearing was strengthened and more species of ornamental fish were bred in the onshore system and larval rearing technology was developed.

Salient results of the work carried out during the year are furnished below.

PROJECT CODE	**DF/RE/1**
PROJECT TITLE	**Investigations on the Resource Characteristics of Elasmobranch**
SCIENTISTS	**S.G. Raje,** G. Mohanraj, P. Livingston, V. Gandhi, K.K. Joshi and P.P. Manojkumar
CENTRES	Mumbai, Madras, Tuticorin, Mandapam Camp, Cochin, Calicut

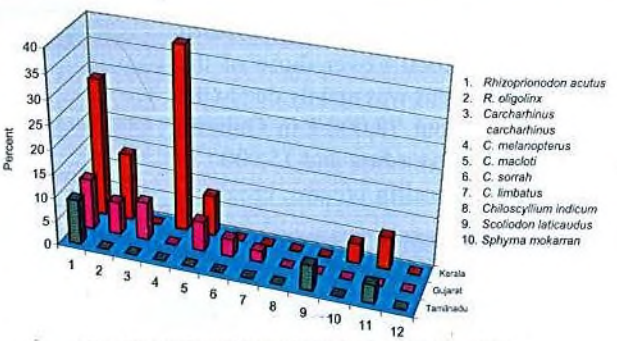
During the year, an estimated 72,000 t of elasmobranchs were landed. Sharks were dominant forming 64% of the elasmobranch catch followed by rays (32.6%) and skates (3.4%). The landings of sharks increased by 11%, but those of skates and rays declined by 3% and 13% respectively over those of previous year. The increase in shark landings is mainly due to increase of 37% in Maharashtra, over 130% increase in Tamilnadu and 18% increase in Gujarat.



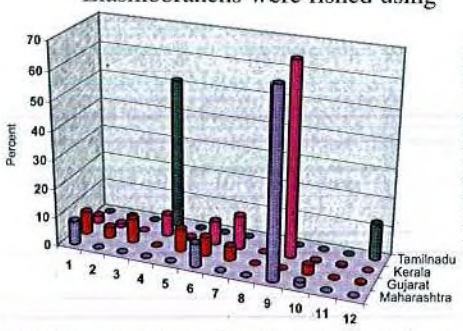
Landings of elasmobranchs in maritime states during 1998-2000

Elasmobranchs were fished using trawl, gillnet, hook and line and *dol* net in different parts of the country. In Maharashtra 96% of the catch was taken by trawl, 3.9% by gillnet and just 0.1% by *dol* net. In Kerala, 72% of the catch was taken by trawl and 28% by gillnet. In Tamilnadu, about 79% was taken by trawl, 19% by gillnet and about 2% by hooks and lines.

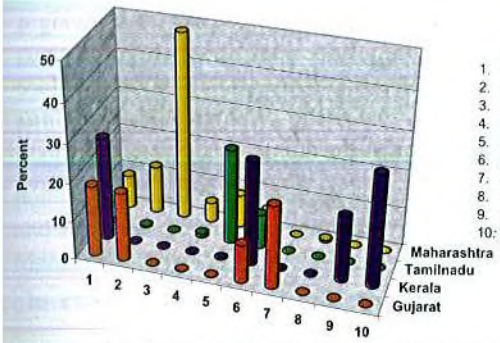
Of about 12 species of sharks fished in different regions, *Scoliodon laticaudus* was dominant in Maharashtra and Kerala and *Carcharinus melanopterus* in Tamilnadu in the trawl landings. In the gillnet landings, *C. melanopterus*, *Rhizoprionodon acutus* and *R. oligolinx* were abundant in Kerala, *R. acutus* and *S laticaudus* in Tamilnadu and *R. acutus, R. oligolinx* and *C. carcharhinus* in Gujarat.



Species composition of sharks in gillnet catches



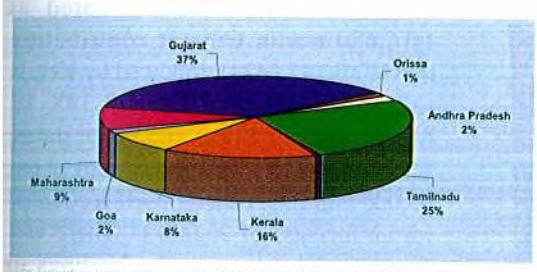
Species composition of sharks in trawl catches in maritime states



Species composition of rays in trawl landings

Among the rays, about 10 species were exploited by trawl in different regions. *Mobula diabolus*, *Dasyatis uaranak*, *D. imbricata* and *Aetobatus narinari* were important in Gujarat, *Gymnura poecilura*, *A. narinari*, *D. uaranak* and *G. micrura* in Kerala, D. *bleekeri* in Tamilnadu and *D. zugei*, *D. imbricata*, *D. bleekeri* and *D. sephen* in Maharashtra.

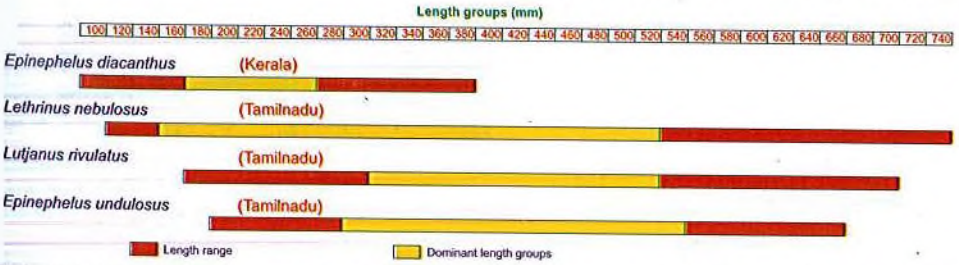
PROJECT CODE	**DF/RE/2**
PROJECT TITLE	**Monitoring the Resources Characteristics of Groupers, Snappers and Pigface breams**
SCIENTISTS	**V. Gandhi,** P. Livingston, P.P. Manojkumar and Rekha J. Nair
CENTRES	Mandapam Camp, Tuticorin, Calicut, Cochin, Vizhinjam, Mumbai



Contribution of each maritime state to the production of perches (groupers, snappers, pigface breams and other perches during 2000

Groupers were fished by traps, gillnet, hook and lines and trawl. An estimated 25,000 t of groupers were landed in India during the year 2000 showing about 60% increase over the previous year. During 1995-2000, the landings varied between 12,000 and 25,000 t with an annual average of about 17,000 t. Maximum landings of 10,000 t were obtained off Gujarat followed by Kerala (4,500 t), Maharashtra (3,800 t), Tamilnadu (3,300 t) and others. *Epinephelus diacanthus* was the most dominant species in Maharashtra and Kerala and *E. tauvina* and *E. areolatus* along southern Tamilnadu. In *E. diacanthus*, the bulk of the catch was represented by immature fishes in Kerala. The length range in the catch of *E. diacanthus* was 102-370 mm in Kerala and 95-405 mm off Maharashtra.

The snappers were taken by hook and line and trawl. The estimated landing in the country was 6,000 t, which is about 3% less than that obtained in 1999. Tamilnadu and Kerala together accounted for 77% of the snapper catch in India. During 1995-2000, the estimated annual average catch was 5,300 t. *Lutjanus rivulatus*,

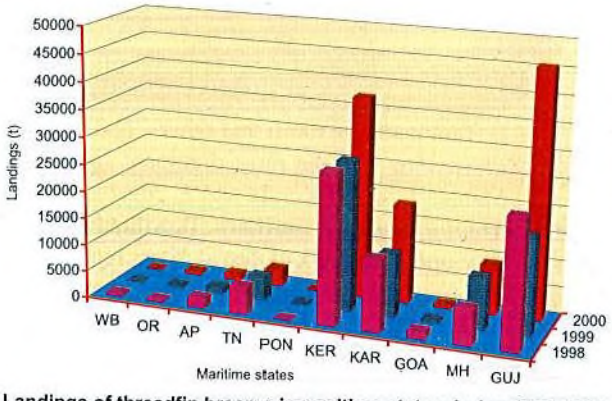


Length range in the catch of some grouper, pigface bream and snapper species in Kerala & Tamilnadu during 2000

L. fulviflamma and *L. kasmira* were the most abundant species in southern Tamilnadu and *L. malabaricus* and *L. lutjanus* in Kerala. *L. rivulatus* was in the 180-700 mm length range along southern Tamilnadu.

An estimated 11,000 tonnes of pigface breams were landed in the country showing a marginal decline over the previous year. Tamilnadu accounted for about 90% of pigface bream catch in the country and *Lethrinus nebulosus* was the dominant species. The length range of this species was 120-290 mm in trawl and 120-740 mm in hook and line.

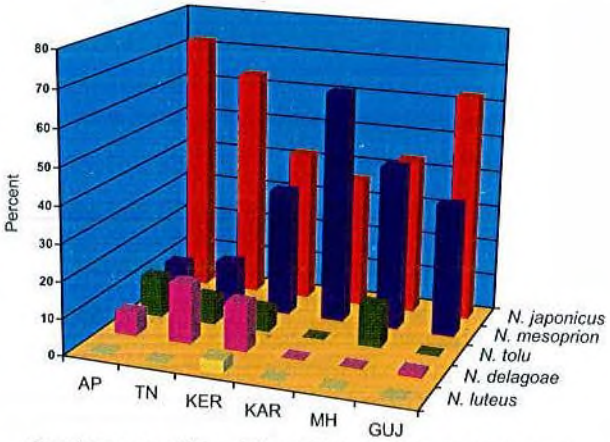
PROJECT CODE	**DF/RE/4**
PROJECT TITLE	**Development of Management Strategies for Sustainable Fishery of Threadfin breams and Silverbellies**
SCIENTISTS	**V. Sriramachandra Murty,** K.K. Joshi, P.P. Manojkumar, P.U. Zachariah, Shoba J. Kizhakudan, E. Vivekanandan and U. Rajkumar
CENTRES	Cochin, Calicut, Mangalore, Karwar, Mumbai, Veraval, Mandapam Camp, Madras, Kakinada, Visakhapatnam



Landings of threadfin breams in maritime states during 1998-2000

In the year 2000, the threadfin bream landings were estimated at 1,16,680 t with Gujarat contributing maximum (45,642 t), followed by Kerala (37,437 t), Karnataka (18,398 t), Maharashtra (9,273 t) and other states. The landings in 2000 increased by about 43,000 t; of this, Gujarat itself accounted for an increase of 25,000 t. There was substantial increase in the landings in Gujarat in comparison to the past two years; Kerala and Karnataka also

THREADFIN BREAMS: Threadfin breams formed about 3 % of the total marine fish landings of India. During 1981 –2000, the catches showed annual fluctuations between 15, 621 t (1981) and 1,16,680 t (2000) with an annual average of 62,843 t. The average annual landings of nemipterids during 1981-90 were 45,368 t, which increased to 80,320 t during 1991-2000. The increase during the latter period is mainly due to the extension of fishing to relatively deeper grounds and multi-day fishing.

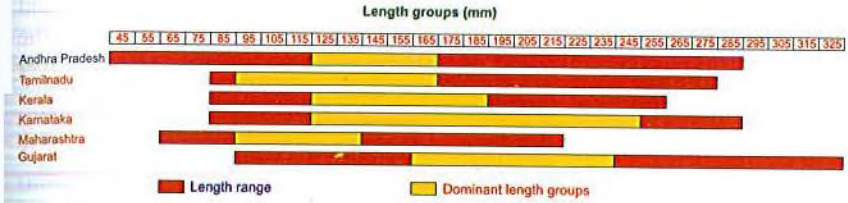


Species composition of threadfin breams in the landings of maritime states in 2000

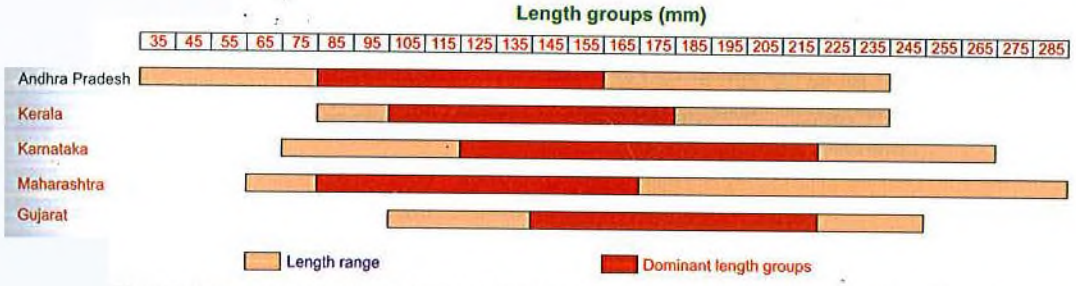
registered considerable increase during the period.

Of the five species contributing to the fishery, two contributed to the bulk of the landings; *Nemipterus japonicus* was the most dominant in Andhra Pradesh, Tamilnadu, Gujarat and Kerala and *N. mesoprion* in Karnataka and Maharashtra.

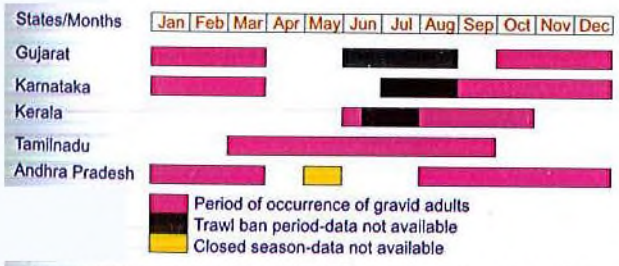
Peak period of landing was October - December in Andhra Pradesh, June –July in Tamilnadu, May-June and August in Kerala, September-October in Karnataka, February – March in Maharashtra and November – December in Gujarat. Population parameters of *N. japonicus* off Karnataka were estimated as: L_∞ = 320 mm, K = 1.4 per year, Z= 5.6, M = 2.2 and the yield per recruit analysis revealed that MSY could be obtained by increasing the fishing effort by 50 %. Off Tamilnadu, the parameters were estimated as L_∞ = 295 mm and K = 1.02 per year.



Length range and dominant length groups in the catches of *Nemipterus japonicus* in different states during 2000



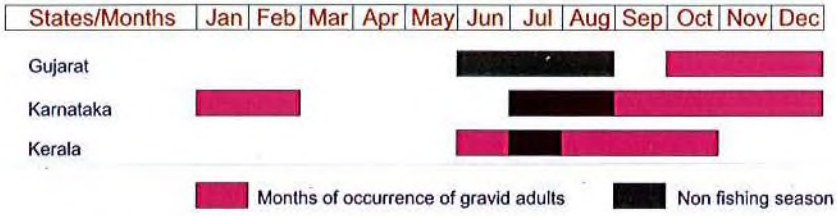
Length range and dominant length groups in the catches of *Nemipterus mesoprion* in different states during 2000



Months of occurrence of gravid adults of *Nemipterus japonicus* in different *regions*

In *N. mesoprion*, the size at first maturity was estimated as 120 mm for females and 146 mm for males off Karnataka. Fecundity was estimated as ranging from 7,400 to 49,700 in fishes of the length range 128 –215 mm. The population parameters were estimated as L_∞ = 290 mm, K= 1.1 per year, Z = 4.2 and M = 1.95.

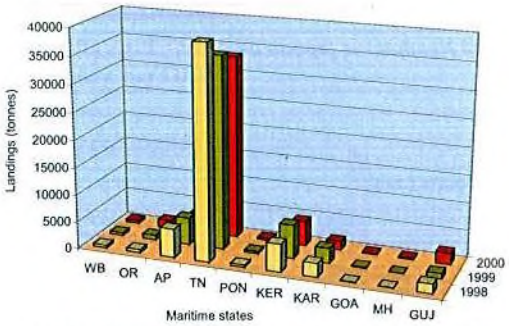
SILVERBELLIES: Silverbellies occurred in the commercial catches all along the coastal waters. The catch



Months of occurrence of gravid adults of *Nemipterus mesoprion*

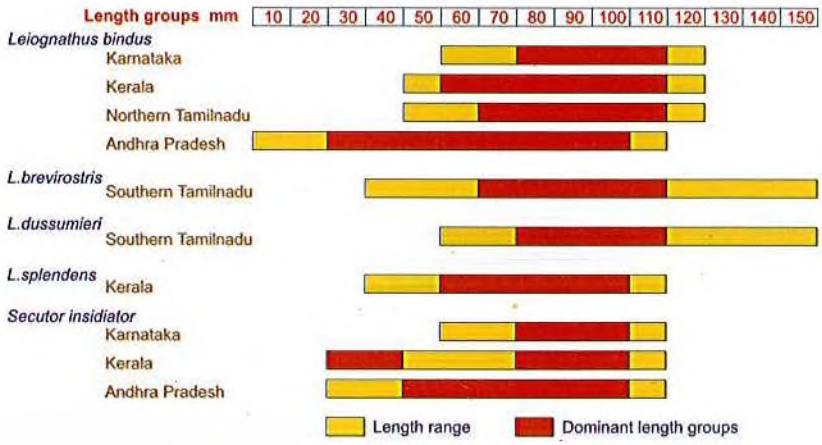
fluctuated widely between 15,763 t (1961) and 91,733 t (1983). East Coast accounted for 79 % of the silverbelly landings. The major contributor was Tamilnadu, which accounted for 69 % of the all India catch. Trawl net was the major contributor for this fishery though purseseine and indigenous gears contributed marginally to the landings in certain regions. The landings over the years showed declining trend.

Off Karnataka, gravid and partially spent fishes of *Secutor insidiator* and *L. bindus* were seen in almost all months with peak during January – May. Males and females were almost in equal proportions. The von Bertalanffy growth parameters of *L. bindus* were estimated as $L\infty$ = 140 mm and K = 1.05 per year.



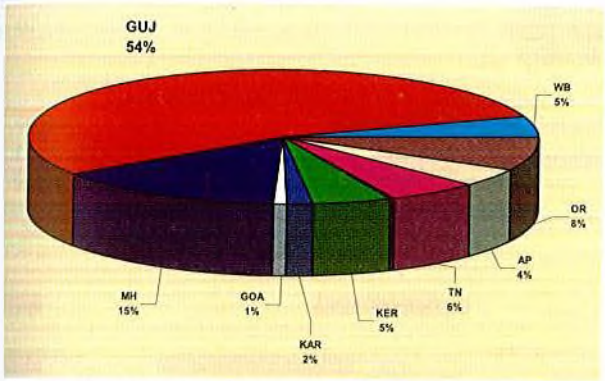
Landings of silverbellies in maritime states during 1998-2000

Months of occurrence of gravid adults of silverbelly species



Length composition of silverbelly species in the landings

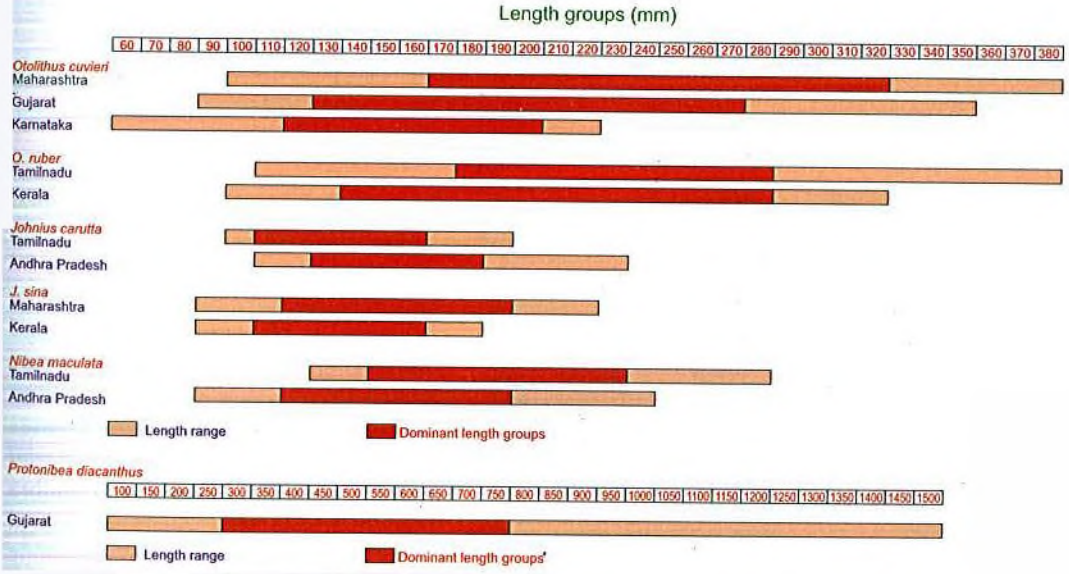
PROJECT CODE	DF/RE/5
PROJECT TITLE	**Development of management strategies for the judicious exploitation of sciaenids**
SCIENTISTS	**G. Mohanraj,** S. Sivakami, M. Feroz Khan, K.V.S. Nair, Shoba J. Kizhakudan, P. Livingston, U. Rajkumar
CENTRES	Veraval, Mumbai, Karwar, Cochin, Tuticorin, Madras, Kakinada, Visakhapatnam



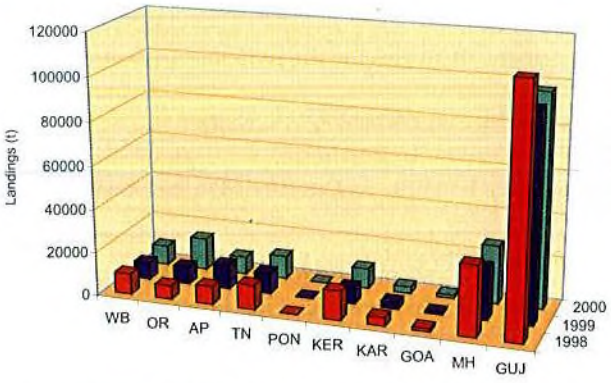
Contribution of each maritime state to the production of croakers (Annual average of 1996-2000)

The sciaenids constitute an important component in the marine fish landings along the Indian coast accounting for 6.5 % of the total marine fish catch. The landings increased considerably due to increased effort and extension of fishing grounds. Trawl was the principal gear in all the states though gillnets also landed these fishes in Tamilnadu and Gujarat. The landings during the year increased by about 8% and Gujarat accounted for more than half of sciaenid landings in India.

The fishery of sciaenids consisted of both larger forms mainly represented by two important commercial species, *Otolithoides biauritus* and *Protonibea diacanthus* and a large number of smaller sciaenids. The number of



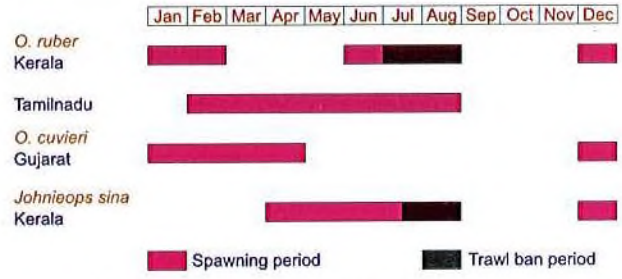
Length composition of some croaker species in the landings during 2000



Landings of croakers in maritime states during 1998-2000

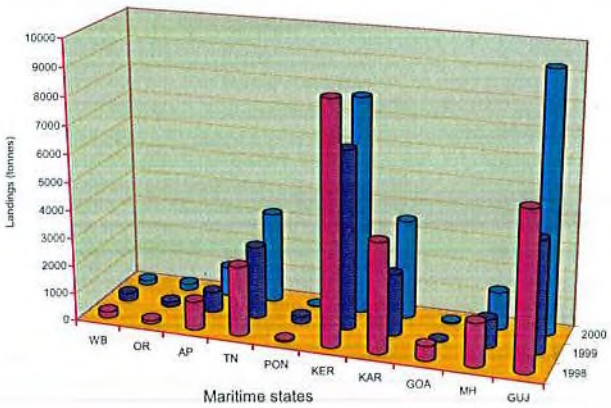
species reported in the commercial landings was 10 in Tamilnadu and 18 in Andhra Pradesh.

Acetes spp formed the major food of *Otolithes cuvieri* and *Johnius glaucus* at Veraval. Fish and Prawns formed the major food of *Johnius carutta* and *Otolithes rubber*. The recruitment of *Nibea maculata* off Kakinada was from December to August. This species spawned during April – November. The L ∞ was estimated as 305 mm and K = 1.27 per year.



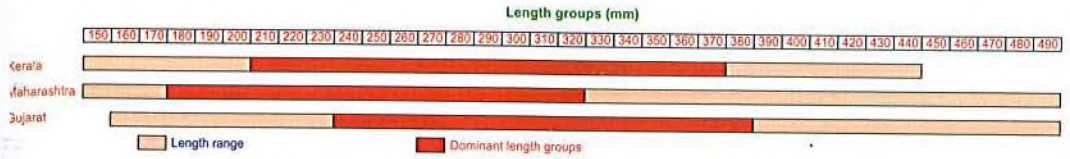
Months of occurrence of gravid adults in some croaker species

PROJECT CODE	**DF/RE/6**
PROJECT TITLE	**Resource characteristics and biology of lizardfishes, threadfins, pomfrets and bull's eye**
SCIENTISTS	**S. Sivakami,** S.G. Raje, Shoba J. Kizhakudan, E. Vivekanandan, M. Feroz Khan and U, Rajkumar
CENTRES	Cochin, Mumbai, Veraval, Madras, Kakinada, Visakhapatnam



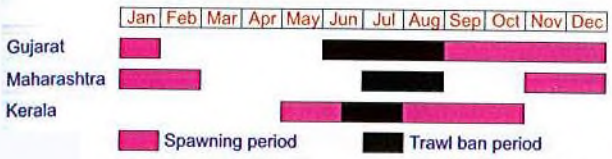
Landings of lizardfish in maritime states during 1998-2000

Lizardfish: Lizardfish landings increased by 5.1% over those of the previous year. Peak landings were obtained during 3rd and 4th quarters in Gujarat and Andhra Pradesh. In Maharashtra, Kerala and Tamilnadu, the peak was during the 3rd quarter. Gujarat contributed the maximum (over 9000 t). Of the 5 species contributing to the fishery, *Saurida tumbil* was the most dominant along Andhra Pradesh, Kerala, Maharashtra and Gujarat and *S. undosquamis* in Tamilnadu. Along northern Tamilnadu, the catch of S.

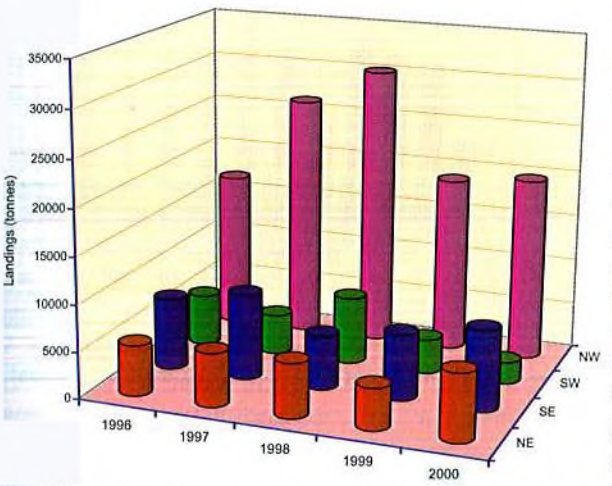


Length range in the catch of *S. tumbil* in different states

undosquamis by trawlers consisted of over 40% of juveniles. The length range in the catch of *S. tumbil* was 150-490 mm at different places with the dominant length groups at 210-370 mm. The spawning periods of *S. tumbil* were determined as September-January in Gujarat, November-February in Maharashtra and May-November in Kerala.



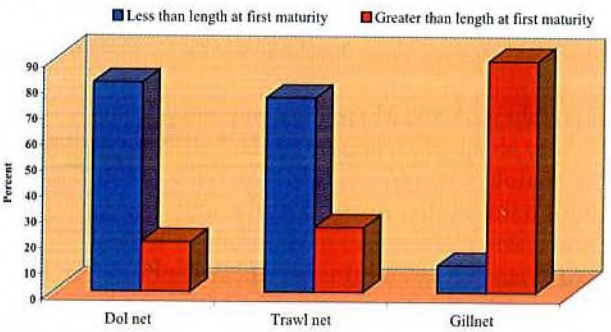
Months of occurrence of gravid adults of *S. tumbil*



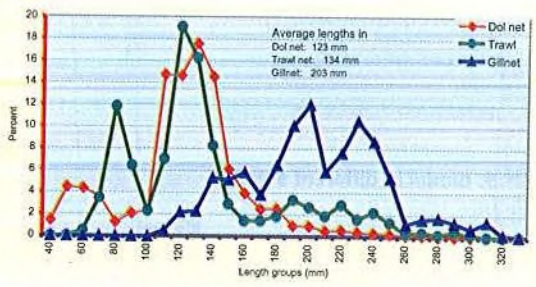
Landings of pomfrets in different regions during 1995-2000

Pomfrets: The all India catch of about 38,000 t showed about 1% increase over the previous year. Northwest coast contributed to the maximum quantities of pomfrets followed by southeast, northeast and southwest coasts. The pomfrets were exploited by trawl, gillnet and the *dol* net. Peak landings were obtained during 1st quarter along Gujarat and 3rd quarter along Maharashtra. The silver pomfret *Pampus argenteus* was the most dominant species forming about 66% of the pomfret landings in the country followed by the black pomfret *Formio Niger* and the Chinese pomfret *P. chinensis*.

Gujarat dominated in the landing of silver pomfret followed by Maharashtra and others. The landings in Maharashtra reveal that the gillnet takes large quantities of silver pomfret in the length range of 170-260 mm, trawl 100-160 mm and 'dol' net 40-170 mm. The average lengths in the catches of each gear are, *dol* net 123 mm, trawl net 134 mm and gillnet 203 mm. The estimated landings in 'dol' net consisted of 11.5 million fishes smaller than length at first maturity and 2.7 million above



Silver pomfret landings (%number of fish) by different gears in Maharashtra

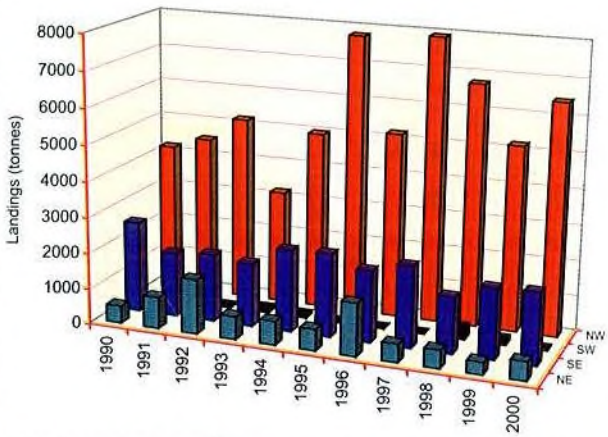


Length frequency distribution of *Pampus argenteus* caught by different gears in Maharashtra

length at first maturity. In the trawl catch, 22.2 million were below the length at first maturity and 7.3 million above. In the case of gillnet, 0.09 million fish caught were juveniles and 0.8 million adults.

Threadfins: The landings of polynemids showed a marginal increase of 15% over the previous year with an estimated landing of about 9,000 t. Northwest coast was responsible for this increased landing. In Gujarat, peak landings were obtained during January-May by trawl and January-February by gillnet. *P. indicus* was the most dominant species followed by *P. heptadactylus, E. tetradactylum* and *P. sextarius* The mean length of P. *indicus* was 310 mm in trawl and 564 mm in gillnet in Gujarat.

Bull's eye: The catches of bull's eye consisted of only one species *Priacanthus hamrur* in Gujarat, Maharashtra and Kerala. The catches were maximum in Gujarat followed by Maharashtra and Kerala. The mean length range of the species in the catches was 210-250 mm in these states. This species appears to be a fractional spawner with spawning occurring during April-July in Kerala.The fecundity is estimated as ranging from 1,55,800 to 7,22,300.



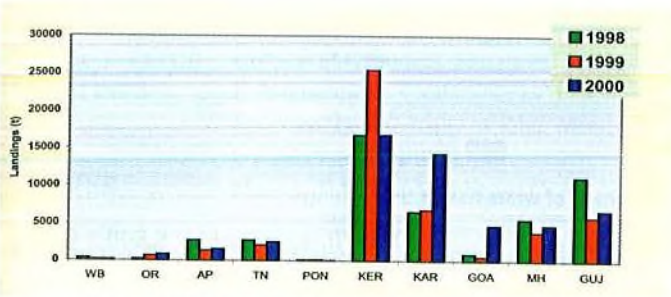
Regionwise landings of threadfins along the Indian Coast

PROJECT CODE	**DF/RE/7**
PROJECT TITLE	**Biology and Fishery of Flatfishes, Goatfishes and Whitefish**
SCIENTISTS	**E. Vivekanandan,** P.U. Zachariah, M. Feroz Khan and Rekha J. Nair
CENTRES	Madras, Mangalore, Calicut, Cochin, Vizhinjam, Mandapam Camp, Karwar, Visakhapatnam

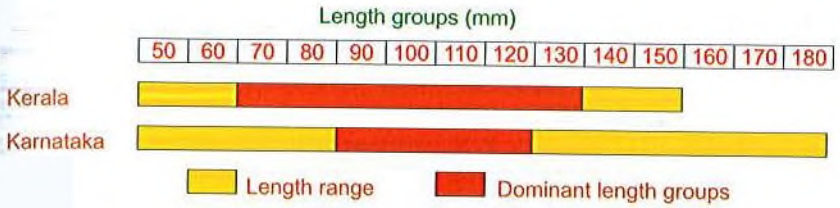
Flatfishes: About 11 species contributed to the fishery along different parts of the Indian coast of which *Cynoglossus macrostomus* was dominant along north Kerala and south Karnataka, *C. bilineatus* along southern Kerala and *C. macrolepidotus* along southern Tamilnadu coasts. The flat fishes were almost exclusively landed by trawlers.

The length at first maturity in *C. macrostomus* was estimated at 135 mm along southern Karnataka. This species spawned during October-December in the region.

Goatfishes: Eight species contributed to the fishery along different parts of the Indian coast of which *Upeneus sundaicus* and *U. tragula* accounted for about 50-95% of the goatfish catch



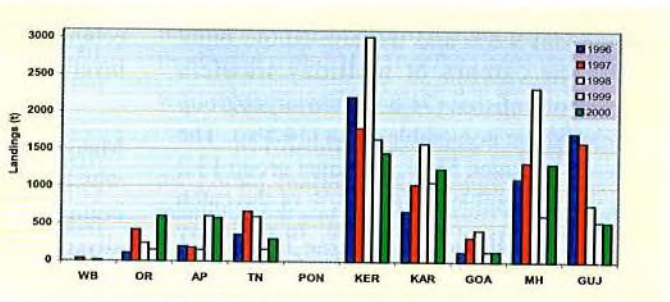
Estimated landings of flatfish during 1998-2000



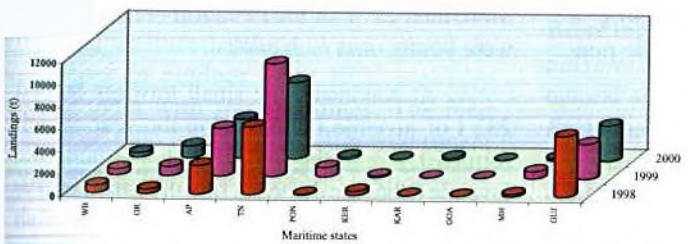
Length composition of *Cynoglossus macrostomus* in the landings

along different parts of the southern Tamilnadu coast. In the northern Tamilnadu however, *U. taeniopterus* was dominant followed by *U. sulphureus* and *U. moluccensis*. Along north Andhra, *U. vittatus* and *U. sulphureus* accounted for over 90% of goatfish catch. Based on the length frequency data collected on *U. taeniopterus* along the Coromandel coast, the von Bertalanffy growth parameters were estimated as K=0.80 per year and L ∞ =270 mm.

Whitefish: At Mangalore, gravid adults occurred during January-June and November-December with peak during January-February. The population parameters were estimated as L ∞ = 250 mm K= 1.1 per year along the Karnataka coast. A critical analysis of the data on the fishery of *Lactarius lactarius* of 1961-1998 period, revealed that



Landings of *Lactarius* in maritime states



Estimated landings of goatfish in different maritme states during 1998- 2000

→ The estimated annual landings increased from about 8,900 t in 1961 to 25,300 t in 1985, but slowly declined to about 5,000 t in 1999.

Length composition of white fish in the landings

→ Along the southeast coast, the landings declined from about 7,000 t in 1961 to about 700 t in 1999.

→ Along the northwest coast, the annual average catch of 154 t during 1961-70 increased to 8,800 t during 1981-90, but declined to about 3,000 t during 1991-2000.

→ The bulk of the landings of this species were obtained by trawlers.

PROJECT CODE	**DF/TR/1**
PROJECT TITLE	**Investigations on the impact of coastal bottom trawling on demersal fishes and macrobenthos**
SCIENTISTS	**N.G. Menon,** P.U. Zachariah, P. Nammalwar and I. Jagadish
CENTRES	Cochin Mangalore, Madras, Mandapam Camp, Karwar, Kakinada

In the small trawlers that operated in the coastal waters off Karwar and Tadri, finfishes formed 47.8 %, the target group (prawns and cephalopods) 9.8% and the non-edible biota 42.5%. The catches of multiday trawlers composed of finfishes (71.6 %), the target group (13.8%) and the non-edible biota (14.5%). The finfishes constituted 53 %, the target group 13.2 % and the non-edible biota 33.8 % of the catch in small trawlers at Mangalore. In multiday trawlers, finfishes formed 79.4 %, followed by target group (17.2 %) and the non-edible biota (3.4 %).

The target group constituted 50.2 % followed by the finfishes (48.7%) and the non-edible biota (1%) at Cochin.

In the small trawlers at Kakinada, finfishes accounted for 64.3 %, followed by the target groups (34.1%) and the non-edible biota (1.6%).

Squilla was the main component of non-edible biota in the trawl catch at Karwar (89.2 % in single day trawlers and 96.7 % in multi day trawlers), followed by Mangalore (84.5 % in SD and 80 % in MD) and Kakinada (47.7 %). The other components were gastropods, bivalves, echinoderms and organism belonging to several invertebrate taxa.

The single day fishing trawlers at Mangalore-Malpe landed 451 t of juvenile fish, which formed 8.5% of the total catch. The major components were flat fishes, *Lactarius* and silverbellies. The multiday trawlers landed 5637 t, which accounted for 23% of the catch. Major components of young fish were rock cods, *Lactarius*, lizardfishes, sciaenids and flat fishes. More than 21 % of the threadfin breams caught were young ones /sub adults.

At Kakinada, the small trawlers landed 232 t of juvenile fishes during the year, which formed 1.1 % of the finfish catch. Among the juvenile fishes the demersal finfish formed 55.7% and the pelagics 44.3 %. The demersal finfish juveniles were estimated as 129 t. Main juvenile components were goat fishes (26.5%) followed by Sciaenids (20.8%), perches (17.6 %), flat fishes (6.6 %), nemipterids 4.6 % and others.

PROJECT CODE	**DF/CUL/3**
PROJECT TITLE	**Culture of Groupers, Snappers, Sea breams, Rabbitfish and Ornamental fish**
SCIENTISTS	**P. Nammalwar,** V.S.Rangasamy, L. Krsihnan, Grace Mathew, T. Narendar, D.C.V. Eastersen, D. Kandasmy, A.Raju, Manpal Sridhar, Molly Varghese, G. Gopakumar, I. Rajendran and I. Jagadish
CENTRES	Madras, Tuticorin, Mandapam Camp, Vizhinjam, Cochin

During the year 2000, the project was implemented at 6 centers (Tuticorin, Mandapam, Chennai, Cochin, Narakkal and Vizhinjam). Brood stock development was carried out at Tuticorin, Mandapam, Chennai, Cochin and Narakkal. Induced maturation studies were done at Mandapam and Narakkal. Live feed culture experiments were conducted at Cochin and Narakkal and ornamental fish culture experiments at Mandapam, Tuticorin and Vizhinjam.

GROUPERS

Collection and transport of seed: Fingerlings of *Epinephelus tauvina* in the length range of 85 – 208 mm (195 numbers) were collected from shore-seine landings and reared at Tuticorin; 61 numbers were transported to Cochin in live condition for further work.

Broodstock development: At Tuticorin, 810 *Epinephelus tauvina,* having mean length of 152 mm TL and a mean body weight of 52 g stocked during December 1998, grew to a mean length of 399 mm and mean weight of 1004 g in 568 days.

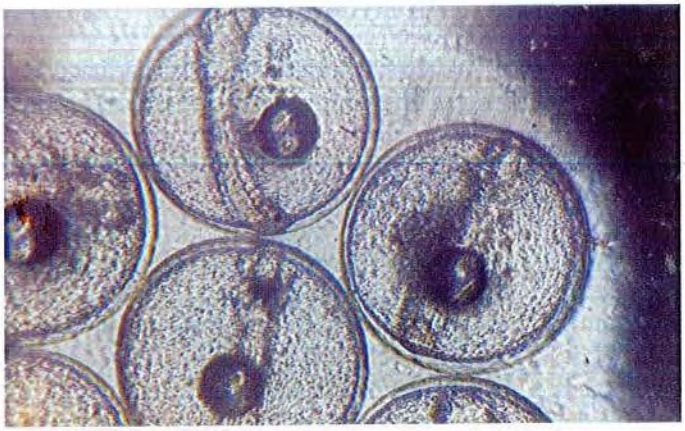
At Mandapm, groupers collected from the wild and cultured ponds were raised to broodstock in outdoor 100 t RCC tanks by feeding them with fresh sardines. The feed conversion ratio was 5.5 – 8.2: 1 in wild caught groupers and 4.9 – 6.5: 1 in pond grown fishes.

Broodstock development of groupers, *Epinephelus tauvina* and *E. malabaricus* and snapper *Lutjanus argentimaculatus* from the juvenile stage was continued at Cochin. At Narakkal, *Epinephelus tauvina* and *E. malabaricus* were reared in silpaulin- lined ponds from March 1999 to December 1999. During the period *L. malabaricus* have grown from a mean size of 519 mm / 3.36 kg to 591 mm / 4.32 kg. During July 2000, *Epinephelus tauvina* with a mean size of 160mm / 60 g and *E. malabaricus* of 164 mm / 77 g were stocked in FRP tanks; during November 2000 they were transported to FHL. During this period *Epinephelus tauvina* grew to a size of 199mm/ 130 g, while *E. malabaricus* grew to 232 mm/ 194 g.

Induced maturation and sex reversal: Ovaprim injection was given at fortnightly intervals for *Epinephelus tauvina* (545-590 mm / 2.4 –3 kg) and the gonadal development was monitored at Mandapam. Further, fishes already implanted with LH-RH pellet, were also treated with ovaprim and maintained.

At Cochin, experiments were carried out on gonad maturation through photoperiod manipulation and positive results were obtained. Retention of sex in hormonally sex-inverted males and synchronization of spawning were obtained through socialization in the culture system.

Breeding and larval rearing of *Epinephelus polyphekadion* at Mandapam: Continuous natural spawning of the camouflage grouper, *Epinephelus polyphekadion* was achieved under captive conditions. The fish spawned in the 5-t FRP tank. They spawned during June (4 days), July (5 days), August (4 days), September (4 days), October (2 days) and November (2 days). The spawning during June to August occurred during full and new moon periods and in the rest of the months it was between the lunar phases.



Early embryo of E. *polyphekadion* produced at Mandapam

***E. polyphekadion* – larva produced at Mandapam**

The spawning took place during night between 9 and 10 p.m.

The fish yielded 0.9 million eggs to 7.3 million eggs. During June, fertilization didn't take place, as the male did not spawn. In the subsequent spawning, the male also spawned and fertilization took place with the rate ranging from 75 to 95 %. The diameter range of the fertilized egg was 0.95 – 1.27 mm. The larvae were hatched out after 18-20 hrs of incubation. A total of 7.3 million larvae were produced, with hatching rate between 50 and 86% and the length range of the hatchlings was 1.43 – 1.60 mm. The larvae could be reared to a maximum of 14 days only.

Culture of live feed: Stock as well as mass culture of rotifers (*Brachionus rotundiformis)* was maintained and monitoring the quality was continued. Cultures were fed with *Nannochloropsis* sp. The stock cultures of freshwater and marine live feed organisms such as *Chlorella* spp, *Isochrysis galbana, Nannochloropis* spp and *Brachionus rotundiformis* in indoors were maintained.

ORNAMENTAL FISHES

a. Clown fishes: At Vizhinjam development of an innovative method for the hatchery production of *Amphiprion chrysogaster* was achieved which can be scaled up for commercial production. Several batches were produced at the hatchery.

b. Damselfishes: Breeding and larval rearing methodology for three species namely, Filament tail damsel, *Neopomacentrus filamentosus*. Yellowtail damsel, N. *nemurus* and Blue damsel, *Pomacentrus caeruleus* were developed on experimental scale. The breeding and larval rearing of *Dascyllus reticulatus, D. trimaculatus, Pomacentrus pavo* and *Chromis viridis* were also attempted with some degree of success at Vizhinjam.

Clownfish breeding unit at Vizhinjam

Early embryos of the ornamental fish *Neopomacentrus filamentosus* at Vizhinjam

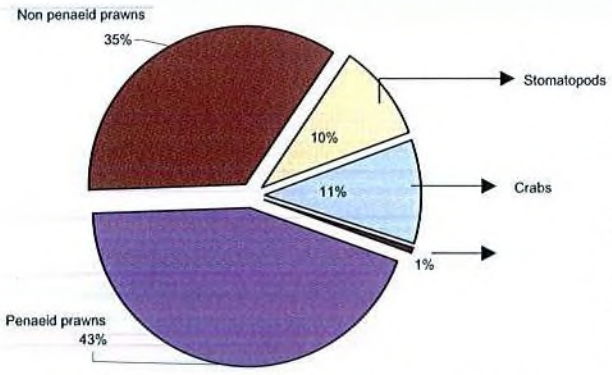
A newly-hatched larva of *N. filamentosus* at Vizhinjam

Eggs of blue damsel, *Pomacentrus caeruleus* at Vizhinjam

Young ones of hatchery-produced blue damsel, *P. caeruleus* at Vizhinjam

CRUSTACEAN FISHERIES DIVISION

The Crustacean Fisheries Division continued monitoring of the exploited crustacean resources and research on seed production and farming technology of penaeid shrimps, lobsters and crabs.



Composition of crustacean landings in the year 2000 in India

The estimated crustacean landing was 4,55,144 t which formed 17 % of the country's marine fish production. There was 14% increase over the landings of previous year. Penaeid prawns formed 44% of the crustacean landing followed by non-penaeid prawns (35%), stomatopods (10%), crabs and lobsters (11%). The highlights of the research findings of the projects implemented by the division are given below

PROJECT CODE	**CF/RE/1.11**
PROJECT TITLE	**Assessment of fishery and resource characteristics of penaeid shrimps of the West Coast of India**
SCIENTISTS	**G. Nandakumar,** E.V.Radhakrishnan, Mary K. Manisseri, K.N.Rajan, K.R. Manmadhan Nair, A.P. Dineshbabu, V.D. Deshmukh, M. Aravindakshan, V.S. Kakati, K.K.Philippose and K.N. Saleela
CENTRES	Veraval, Mumbai, Karwar, Mangalore, Calicut, Cochin, Vizhinjam

The penaeid prawn landings along the west coast were estimated as 1,44,706 t which accounted for 72 % of national penaeid prawn production. The landings increased by 69% in Goa, 46% in Maharashtra, 42% in Kerala, and 19% in Gujarat and declined by 26% in Karnataka. In Kerala, trawlers operated in depths upto 300m and landed 21,353 t (40kg/hr) of prawns of which 66% were pandalids and rest penaeids. Along Karnataka, trawlers based at Mangalore started deep sea fishing operations in April.

Trawl landings: Along the Gujarat coast at Veraval, dominance of *Solenocera crassicornis* and considerable decline in the landings of *P. stylifera* were the major changes in the fishery. Large-sized prawns such as *Penaeus penicillatus, P. semisulcatus, P. latisulcatus, P. merguiensis* and *P. monodon* together accounted for 2 % of the landings. Along Maharashtra coast, at New Ferry Wharf, the landings of *P. stylifera* declined during postmonsoon period. Average annual catch of *P. stylifera* in the postmonsoon period in the last 5 years was estimated at 3350 t against 808 t in the current year thereby registering a decline of 76%. Non-conventional species such as *Metapenaeopsis stridulans, S. choprai* and *Trachypenaeus curvirostris* dominated the fishery during the postmonsoon period.

Along Karnataka, trawlers based at Mangalore and Malpe together landed 2687t (1.6 kg/hr) against 2586 t (1.7 kg/hr) in the previous year. *T. curvirostris*, which was the second dominant constituent in 1999, contributed only

Details of fishery and biology of penaeid prawns landed at selected centers along west coast

State	Place of observation	Total landing (t)	Catch per hour (kg)	Species	Percent	Dominant size groups in the fishery (mm)
Gujarat	Veraval	7965 (+ 9.3%)	4.4	*Solenocera crassicornis*	41	56 – 85
				Parapenaeopsis stylifera	29	86 – 110
				Solenocera choprai	5	91 – 110
				Metapenaeus kutchensis	4	121 – 135
				Others	2	
Maharashtra	New Ferry Wharf	12310 (+ 3.7%)	8.3	*P. stylifera*	31	81-100
				S. crassicornis	25	66-100
				M. affinis	11	
				M. monoceros	11	
				Metapenaeopsis stridulans	9	
Karnataka	N. Kanara (Karwar)	492 (+ 117%)	7.5(+31%)	*P. stylifera*	50	81 – 110
				M. dobsoni	36	81 – 100
				M. affinis	10	91 – 100
				P. merguiensis	2	
	S.Kanara (Mangalore)	2687 (+ 4%)	1.6	*M. monoceros*	33	108 – 138
				Solenocera spp	20	
				P. stylifera	18	68 – 98
				M. dobsoni	18	58 – 88
				P. canaliculatus	6	
Kerala	Calicut	1728 (+ 230%)	79	*M. dobsoni*	52	71 – 100
				P. stylifera	25	71 – 90
				P. indicus	11	
	Kochi	6427 (+ 54 %)	13.4 (+ 63%)	*M. dobsoni*	54	56 – 90
				P. stylifera	41	71 – 90
	Sakthikulangara - Neendakara	12158 (+ 63 %)	12 (+133%)	*P. stylifera*	75	71 – 85
				M. dobsoni	12	
				T. curvirostris	6	
				M. monoceros	5	

Spawning period		
Maharashtra	*P. stylifera*	March - April
	S. crassicornis	February - March
Karnataka	*M. dobsoni, P. stylifera*	November - April
	M. monoceros	November - December
Kerala	*P. stylifera, M. dobsoni*	November - April

+Indicates increase in landing compared to previous years landing)

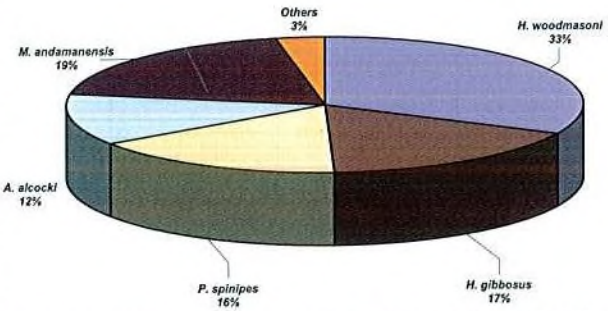
2% in the current year. *P. canaliculatus* the most favored item among the exporters contributed to 150 t (6%) against 2 t in 1999, registering 75 fold increase in the fishery. In addition to this, 32 t of *Metapenaeus dobsoni* were landed between January and March by purse seine.

Along Kerala, the penaeid prawn catches at Calicut revealed an increase of 258% in *M. dobsoni,* 178% in *P. stylifera* and 342% in *P. indicus* over the previous year while at Kochi the landings of *M. dobsoni* and *P. stylifera* improved by 74%, and 33% respectively. *Karikkadi* (*P. stylifera*) landings during June to September (monsoon period) at Kochi amounted to 2140 t (20 kg/hr) against 1347t (11 kg/hr) in the previous year. At Sakthikulangara-Neendakara *P. stylifera* landings during monsoon increased by 229% over the previous year. A ban on trawling for 45 days was effective along the Kerala coast during the monsoon period (June – July).

Artisanal prawn fishery: In Karnataka, ring seines landed 58 t (34 kg/unit) of prawns at Panambur, Malpe and Mangalore of which 90% was contributed by *M. dobsoni* and 7% by *P. indicus*. Hand trawls at Mangalore fished 7 t (15 kg/unit) of prawns dominated by *P. stylifera* (66%) and *M. dobsoni* (28%). Along the Kerala coast at Calicut ring seines and pair trawls landed 28 t of *M. dobsoni* in June registering 24% increase over the previous year. At Fort Kochi ring seines netted 100 t (160 kg/unit) of prawns in the same month, which was composed of *M. dobsoni* (65%) and *P. indicus* (35%). Trammel net (*Konchuvala*) operations at Vizhinjam and Manakudy together landed 50 t of prawns against 231 t in the previous year indicating a decline of 78% in the fishery. Fishery was confined to the monsoon period. *P. indicus* (77%) was the dominant component, with *P. semisulcatus, P. latisulcatus, M. monoceros* and *P. canaliculatus* being the other species. *P. indicus* fishery was supported by 116-170 mm size groups in males and 111-185 mm in females. Spawners were available in good numbers between May and August.

Prawn fishery in the nursery grounds: In Kerala, stake nets operating in the Korapuzha estuary of Calicut, landed 53 t (8 kg/unit) of juvenile prawns composed of *M. dobsoni* (82.7%), *M. monoceros* (12.5%) and *P. indicus* (4.8%). *M. dobsoni* of length range 46-55 mm were dominant. At Thevara in Kochi backwaters, about 425 t of prawns were estimated to have been landed by stake nets at a catch rate of 6 kg/unit. The catch and catch rate improved by 9% and 16% respectively over the previous year. Juveniles of *M. dobsoni* supported 79% of the fishery followed by *P. indicus* (16%) and *M. monoceros* (5%). 51-55 mm size was the modal class in *M. dobsoni* for both sexes.

Deep-sea prawn fishery: Deep-sea prawn fishing that commenced for the first time in November 1999 along the Kerala coast was extended to Mangalore in April 2000. Deep-sea prawn catch at Sakthikulangara (Neendakara), Kochi and Munambam together was estimated at 21,353 t at a catch rate of 40 kg/hr and 696 kg/boat trip. Centrewise catch and catch/hr amounted to 14,238 t and 39 kg/hr at Sakthikulangara (Neendakara), 3510 t and 49 kg/hr at Kochi and 3605 t and 38 kg/hr at Munambam respectively. pandalid prawn *Heterocarpus woodmasoni* (32.5%), *H. gibbosus* (17.2%) and *Plesionika spinipes* (16.3%)



Species composition of deep-sea prawn fishery in Kerala in 2000

Deep-sea prawn catch at Mangalore landing centre.

dominated the deep-sea prawn fishery of Kerala.

Trawlers based at Mangalore landed 234 t of deep-sea prawns with a catch rate of 505 kg/ boat trip in April, May, November and December. Composition of the fishery strikingly differed from that of Kerala with domination of penaeid prawns such as *Aristeus alcocki* (56%) and *Solenocera hextii* (24%). Pandalid prawns belonging to the genus *Heterocarpus* Sp. supported the rest of the fishery.

Biological data on deep-sea prawns

Species	Sex	Length range (mm)	Period of peak occurrence of berried females
Heterocarpus woodmasoni	M	106 – 120	
	F	111 – 120	January-April
H. gibbosus	M	111 – 120	
	F	106 – 125	Feb, March, November
Plesionika spinipes	M	81 – 105	
	F	91 – 105	Throughout the year
Metapenaeopsis andamanensis	M	86 –95	
	F	86 – 95	Rare except in March
Aristeus alcocki	M	81 – 95	
	F	126 – 155	All months

Details of fishery and biology of penaeid prawns landed at selected centers along the east coast

State	Place of observation	Total landing (in tonnes)	Catch per hour (kg)	Species	% Occurrence in the fishery	Dominant size groups in the fishery (mm)
Tamilnadu	Tuticorin	136 (- 23%)	14.6 (- 13%)	*Penaeus semisulcatus*	91	
				Penaeus indicus	6	
	Mandapam	576 (- 11%)	1.2	*Penaeus semisulcatus*	52	106 - 150
				Metapenaeopsis stridulans	31	
				Trachypenaeus pescadorensis	9	
				Metapenaeus burkenroadi	7	
	Chennai	2203 (-3%)	2.3 (+11%)	*M. dobsoni*	20	61 - 85
				Penaeus indicus	17	
				M. monoceros	1	
				Parapenaeopsis maxillipedo	9	
				M. stridulans	7	
				Penaeus semisulcatus	6	
Andhra Pradesh	Visakha-patanam	3394 (+ 242%)	2.9 (+57%)	*M. monoceros*	24	
				M. dobsoni	13	
	Kakinada	7720 (+14%)	10.2 (+20%)	*M. monoceros*	32	71 – 90
				M. dobsoni	26	76 – 90
				M. brevicornis	11	
				Solenocera crassicornis	8	
				Others	3	
Orissa	Paradeep	488 (- 8%)	4.5	*P. hardwickii*	29	
				M. dobsoni	16	71 – 90
				M. affinis	13	101 - 125
				P. stylifera	12	
				M. lysianassa	9	
				Solenocera crassicornis	7	

(+Indicates increase and - decrease in the landing compared to previous year)

PROJECT CODE	CF/RE/1.12
PROJECT TITLE	**Assessment of fishery and resource characteristics of the penaeid Shrimps of the East Coast of India**
SCIENTISTS	**G. Maheswarudu,** G. Sudhakara Rao, M. Rajamani, V. Thangaraj Subramanian K.N. Saleela and E. Dhanwanthari
CENTRES	Tuticorin, Mandapam Camp, Chennai, Kakinada Visakhapatnam

Trawl fishery: Along the east coast, the total landing of penaeid prawns was estimated as 56,143 t, which accounted for 28 % of all India landings. Andhra Pradesh (11.2%) and Tamilnadu (10.9%) contributed maximum landings followed by Orissa (3.4%), West Bengal (2.1%) and Pondicherry (0.2%). While the fishery declined by 6.36% in Tamilnadu and 9.58% in Andhra Pradesh over the previous year, it improved by 60% in Orissa and 58% in West Bengal.

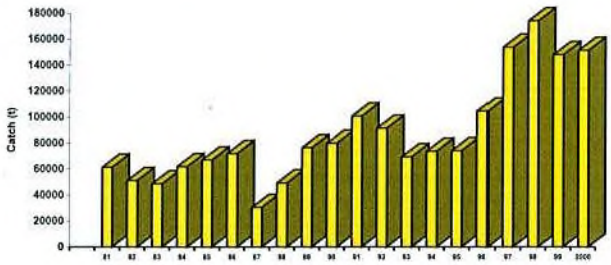
At Chennai along the Tamilnadu coast, prawn fishery was characterized by multiplicity of species numbering more than 20 of which only *M. dobsoni* , *P. indicus*, *M. monoceros*, *Parapenaeopsis maxillipedo*, *M. stridulans* and *P. semisulcatus* were fished in sizeable quantities. Spawners of *M. dobsoni* were abundant in January, February, May and July. At Kakinada along the Andhra Pradesh coast, out of 21 species represented in the fishery, dominant species were *M. monoceros*, *M. dobsoni*, *M. brevicornis* and *S. crassicornis*. Larger species such as *P. indicus*, *P. monodon*, *P. semisulcatus*, *P. merguiensis* and *P. japonicus* together supported 3.4% of the fishery. Dominant sizes supporting the fishery were 76-90 mm in *M. dobsoni*, 71-90 mm in *M. monoceros*, 91-140 mm in *P. indicus* and 141-220 mm in *P. monodon*. Juveniles of *M. monoceros* below 100 mm formed nearly 85% of the fishery. At Paradeep, along Orissa coast prawn fishery was dominated by small and medium sized prawns such as *P. hardwickii*, *M. dobsoni*, *M. affinis*, *P. stylifera*, *M. lysianassa* and *S. crassicornis*. Maximum landings were obtained during October - January. Dominant sizes supporting the fishery were 71-90 mm in *M. dobsoni*, 106-135 mm in *M. monoceros*, 101-125 mm in *M. affinis*, 141-160 mm in *P. merguiensis* and 181-220 mm in *P. monodon*.

Artisanal fishery: Along the Tamilnadu coast at Tuticorin, indigenous gear 'Thallumadi' landed 17 t of prawns at a catch rate of 2.4 kg/unit registering a decline of 29 and 23%, respectively over the previous year. *P. semisulcatus* (94%) dominated the fishery. In the gill net operations at Periathalai near Tuticorin, 9 t were landed (0.5 kg/unit) which composed of *P. indicus* (77%) and *P. semisulcatus* (23%). 16 t (0.3 kg/unit) of *P. semisulcatus* juveniles were fished by 'Thalluvalai' at Mandapam. At Puri, in Orissa, disco and gill nets caught 83 t of prawns at a catch rate of 0.7 kg/unit, major species supporting the fishery being *P. indicus* (84%) and *P. merguiensis* (8%).

PROJECT CODE	CF/RE/1.13
PROJECT TITLE	**Investigations on the non-penaeid shrimp fishery of the North-West Coast of India**
SCIENTISTS	**V.D. Deshmukh,** A.P. Dinesh Babu and Joe K. Kizhakudan
CENTRES	Mumbai, Veraval

The nonpenaeid landings in the country were estimated as 1,57,250 t registering a marginal increase of 2% over the previous year. This includes 17,604 t of pandalid prawns landed in Kerala and Tamilnadu from deep-sea fishing operations. Total nonpenaeid landings in the

northwest coast was 1,25,556 t, of which 66% was contributed by Gujarat and rest by Maharashtra. The catches declined by 4.3% in Gujarat and 7.3% in Maharashtra over the previous year. Non-penaeid prawn resources are largely exploited by 'Dol' and trawl nets in both the states. Investigations were carried out on the resources exploited by 'dol' nets at Nawabunder and Rajpara in Gujarat and Versova in Maharashtra. Trawl fishery was studied at Veraval in Gujarat and New Ferry Wharf (Mumbai) in Maharashtra.



All India non-penaeid prawn landings (t) during 1981-2000

At Versova in Maharastra 'Dol' nets landed 1,579 t of non-penaeids at a catch rate of 32 kg/haul, annual catch improved by 24% and catch rate marginally declined by 3% over the previous year. *Acetes* spp. (74%) and *Nematopalaemon tenuipes* (25%) were the major contributors to the fishery. While fishery of *Acetes* spp. remained stable, landings of *N. tenuipes* (+279%) and *E. ensirostris* (+383%)improved considerably. Trawlers at New Ferry Wharf landed 3944 t with a catch rate of 2.7 kg/haul, both catch and catch rate improving by 22% and 29% respectively over the previous year. Entire catch was constituted by *N. tenuipes*. 45-57 mm-sized prawns formed the mainstay of the fishery. Peak spawning took place in April-May and July.

In Gujarat, at Nawabunder and Rajapara the *dol nets* landed 13,696 t (44 kg/haul) and 7,793 t (44 kg/haul) of non-penaeids respectively. Catch increased by 46% at Nawabunder and declined by 3% at Rajapara over the previous year; the catch rate increased by 55% at Nawabunder and declined by 12% at Rajapara.

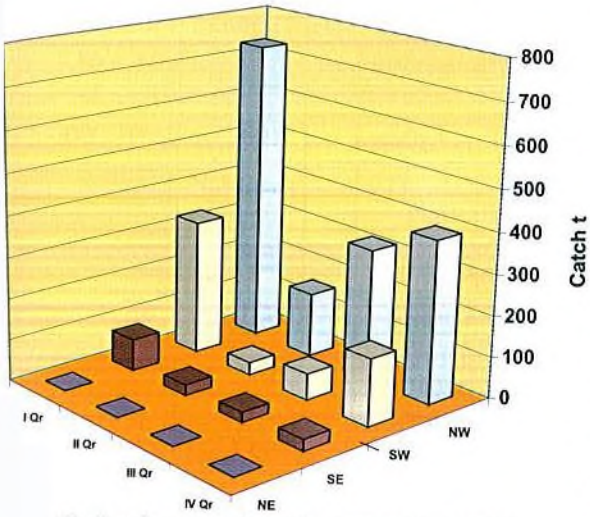
Acetes spp. dominated at Nawabunder (81%) and Rajapara (50%). *N. tenuipes* supported 42% of the fishery at Nawabunder and 16% at Rajapara. The rest of the fishery was contributed by *E. ensirostris*. Trawlers based at Veraval registered a catch of 21,217t at a catch rate of 414 kg/boat trip. The catch improved by 57% over the previous year. *Acetes* spp. contributed to 96% followed by *N. tenuipes* (3%). Mature and berried females of *N. tenuipes* were maximum in September (61%) and *E. ensirostris* in April.

PROJECT CODE	**CF/RE/1.14**
PROJECT TITLE	**Investigations on the exploitation, management and conservation of lobster and crab resources of India**
SCIENTISTS	**Mary K. Manisseri,** Joe K. Kizhakudan, V.D.Deshmukh, V.S.Kakati, A.P.Dinesh Babu, K.K. Philippose, E.V. Radhakrishnan, K.N. Saleela, M. Rajamani and K.K. Sukumaran
CENTRES	Veraval, Mumbai, Karwar, Mangalore, Cochin, Calicut, Vizhinjam, Chennai, Tuticorin, Mandapam Camp

Lobster: The total estimated landing of lobsters in India during the year 2000 was 2,387 t, as against 2093 t in 1999. Maximum landing was reported in Gujarat (43%) followed by Maharashtra (26%), Kerala (22%) and Tamilnadu (6%). There were no landings in Orissa and West Bengal. The improvement seen in the lobster landing in Kerala and Karnataka was due to the catch of the deep sea lobster, *Puerulus sewelli*, taken along with the deep-sea

prawns from about 200-400 m depth.

At Veraval, small sized females of *Panulirus polyphagus* were more during February-March. Females dominated the fishery.



Regionwise quarterly landings of lobsters in 2000

Smaller size groups of *T. orientalis* were observed during January-April and larger sizes during the postmonsoon period. The trap fishery for lobsters at Sutrapada was of a lesser magnitude. At New Ferry Wharf, Mumbai, peak landing was recorded during September-October. The percentage of berried females was maximum in September.

Along Karnataka, at Mangalore, deep-sea trawling was done for the first time during April-May and November-December 2000. Of the total crustacean landing of about 261 t, 25.3 t were constituted by *P. sewelli* and 2 t by *Nephropsis stewarti*. In Kerala the spiny lobster fishery along Thikkodi-Dharmadom stretch was mainly by bottom-set gill nets. Catch was maximum during October-December. The total landing of *P. sewelli*, at the Munambam fishery harbour, was 68 t with major landings (51 t) during January-March. There was no landing in October due to a self-imposed ban on trawling by the fishermen. 26% of the female lobsters were found in fully mature/berried stages. At Muttom, the peak season was in September. The total catch at Vizhinjam was only 631 kg, formed by a single species, *P. homarus*. The traps were used only during October-December.

Along the Tamilnadu coast, the estimated landing was 4.6 t at Kayalpattinam, near Tuticorin where bottom set gill nets were used for fishing. Peak landing was recorded in March. The spiny lobster catch by bottom set gill net at Kovalam near Chennai was 2 t with peak during March and May. *P. homarus* dominated the fishery followed by *P. versicolor*. The fishery for the sand lobster *T. orientalis*, exploited by mechanised trawl nets, improved from 8.1 t during the previous year to 12.1 t in 2000.

Crab fishery: The total estimated catch of crabs was 48,259 t as against 27,547 t in 1999. The fishery showed a marked improvement compared to the previous years. With a total landing of 20852 t, Gujarat contributed maximum (43%) to the fishery. Tamilnadu, Kerala and Andhra Pradesh contributed to 28%, 12% and 6% respectively. A regionwise analysis showed that the northwest region contributed maximum (45%) to the landing followed by the southeast (34%) and southwest (17%) coast.

At Veraval, *Charybdis cruciata* contributed to 7.7% of the catches. At New Ferry Wharf, Mumbai, the total catch was 277.3 t at a catch rate of 9.9 kg/boat trip with maximum in October and minimum in July. *C. cruciata* predominated the fishery (44%) followed by *P. sanguinolentus* (6 %), *P. pelagicus* (5.%) and non-edible species. Percentage of berried females was maximum in December.

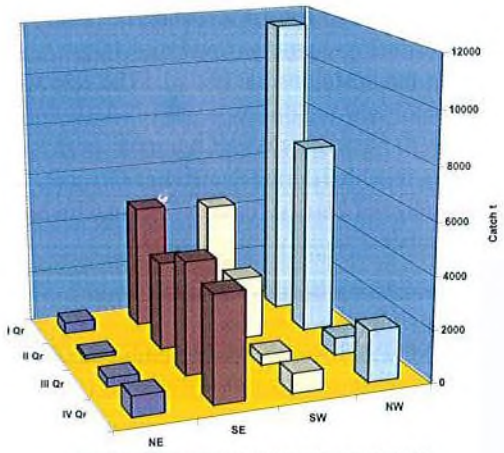
In Karnataka, the trawlers landed 978 t of crabs along the Mangalore-Malpe coast. In the indigenous fishery, ringseines and hand trawls were operated at Malpe for the exploitation of crabs during the monsoon months. Along Kerala, the total estimated

Fishery and biology of lobsters

State	Landing center	Total landing (t)	CPUE (kg)	*Species*	% contrib-ution	Modal length class (mm)
Gujarat	Veraval	168	3.27	*Panulirus polyphagus*	39	M 83 F 80
				Thenus orientalis	61	M 68 F 75
Maharashtra	New Ferry Wharf	105	3.87	*P. polyphagus*	100	160, 280
Karnataka	Mangalore	27		*P.sewelli*		
				Nephropsis stewarti		
Kerala	Calicut	1.45	1	*P.homarus*	93	65
	Munambam	68		*P.sewelli*		
	Muttom	7	0.8	*P.homarus*	82	
	Vizhinjam	631		*P.homarus*	100	
Tamilnadu	Kayalpatttinam	4.6	0.5 to 1.2	*P.ornatus*	52	
	Kovalam	2	1.01	*P.homarus*		

landing of crabs at Puthiyappa, Calicut was maximum in the premonsoon months. At Cochin Fishery Harbour 82% of the landing was recorded during January-May. 28% of the female crabs were in berried stage in *P. sanguinolentus*, and 48% in *C. cruciata*. Sexes were more or less equally distributed in *P. sanguinolentus* whereas males predominated (77%) the catches of *C. cruciata*. At Vizhinjam, an estimated total of 11 t of crabs, (96% *P. sanguinolentus)* were landed by trammel nets (*Konchuvala*) operated from catamaran. Peak landing was recorded in June-July.

In Tamilnadu, estimated landing of crabs by bottom set gill nets at Tharuvaikulam, Tuticorin during the year was 107 t, at the c.p.u.e. of 15.7 kg. Maximum catch was recorded in March. *P. pelagicus* predominated the fishery contributing to 44 %, followed by *P. sanguinolentus* (22 %). 178 t of crabs were landed by trawlers at Mandapam where the fishery was constituted by a single species (*P. pelagicus*). At Thoppukkadu, 10 t of crabs were landed using



Regionwise quarterly landings of crabs in 2000

Nanduvalai, 28% of which was constituted by *Scylla tranquebarica*. The crab landings by trawlers at Chennai, during the year was 653 t. *P. sanguinolentus* dominated the fishery (55%) followed by *Podophthalmus vigil* (11%) and *P. pelagicus* (9%). Berried females were more during

April. Along Andhra Pradesh coast, 344 t of crabs were landed at Kakinada by small trawlers. 63% of the fishery was constituted by *P. sanguinolentus* followed by *C. lucifera* (17%), *C. cruciata* (9%) and *P. pelagicus* (9%). The non-edible crab fishery (226 t) was predominated by *C. callianassa*.

Catch, Catch rate and species composition of crabs

State	Landing center	Total landing (t)	CPUE Kg	*Species*	% contribution
Gujarat	Veraval	8988		*Charybdis cruciata*	8
Maharashtra	New Ferry Wharf	277	9.9	*C. cruciata*	44
				Portunus sanguinolentus	5.5
				Portunus pelagicus	5.0
Karnataka	Karwar	211	3.2	*P.pelagicus*	81
				P.sanguinolentus	15
				C.cruciata	3
	Mangalore – Malpe	978.5		*P. sanguinolentus*	42
				P. pelagicus	32
				C.cruciata	26
Kerala	Calicut	314	14.3	*P.pelagicus*	53
				C. cruciata	28
				P. sanguinolentus	19
	Cochin	253		*P.pelagicus*	
				C. cruciata	
				P. sanguinolentus	
	Vizhinjam	10.7		*P. sanguinolentus*	96
Tamilnadu	Tuticorin	107	15.7	*P.pelagicus*	44
				P. sanguinolentus	22
	Mandapam	178		*P.pelagicus*	100
	Thoppukadu	10		*Scylla tranquebarica*	28
	Kasimedu	653		*P. sanguinolentus*	55
				Podopthalmus vigil	11
				P.pelagicus	9
Andhra Pradesh	Kakinada			*P. sanguinolentus*	63
				C .lucifera	17
				C. cruciata	9.3
				P.pelagicus	8.8

C.cruciata dominated the fishery at Veraval, Mumbai and Cochin, *P. pelagicus* at Karwar, Calicut, Tuticorin and Mandapam and *P. sanguinolentus* at Mangalore, Chennai and Kakinada.

PROJECT CODE	**CF/RE/3**
PROJECT TITLE	**Development of artificial reefs as areas of high fisheries potential through sea ranching and sea farming**
SCIENTISTS	**M. Rajamani** and K.K. Philippose
CENTRES	Tuticorin and Calicut

Ten triangular modules, each module consisting of 3 plates were released in May. 73 triangular modules were released in the sea off Tharuvaikulam at a depth of 6 m in October 2000.

The sea weed *Gracilaria edulis* tied to concrete hollow blocks kept in 1 t tank filled with sea water showed good growth of algal filament upto 121 mm. Sea weeds simply dispersed in sea water in cement tanks had low growth rate indicating that the sea weed can be transplanted on concrete blocks used for constructing artificial reefs.

An artificial reef of 10,000 sq m was developed off Dharmadom in Kannur District at a depth of 12-15 m. 110 triangular modules of 5' x 5' x 5' size were used for the construction of the reef. Regular fishing in the reef site started in May. During the year 552 t of fishes were caught by 4219 units at a catch rate of 131 kg/unit. Dominant species supporting the fishery in the reef area were *Sardinella longiceps* (60%) and *Rastrelliger kanagurta* (18 %). *Ambassis* spp. (11%) and *D. punctatum* (4%) formed minor components. September was the most productive month supporting 38% of the overall catch.

PROJECT CODE	**CF/CUL/1.9**
PROJECT TITLE	**Seed production, experimental farming and tagging of marine prawns**
SCIENTISTS	**V.S.Kakati,** E.V.Radhakrishnan, G. Nandakumar, K.R.Manmadhan Nair, P.E.Sampson Manickam, Josileen Jose, G. Maheswarudu, Miriam Paul and P.T.Sarada
CENTRES	Karwar, Cochin, Minicoy, Mandapam, Visakhapatnam

Experiments on broodstock development, induced maturation, seed production, searanching and experimental farming of two commercially important shrimps *Penaeus monodon* and *P. semisulcatus* were carried out.

Seed production and searanching of the green tiger prawn, *Penaeus semisulcatus:* Seed production and searanching of the commercially important shrimp *Penaeus semisulcatus* were continued. Nineteen hatchery runs were carried out using 34 spawners collected from the wild. For each hatchery run 1-6 spawners of total length 132-200 mm and 15-65 g weight were used. Survival from nauplius to postlarva (PL_1) ranged from 35 to 98 % (Mean, 79 %). Maximum production of 1 million postlarvae was achieved in December.

Experimental farming of penaeid prawns: Experimental farming of *P. monodon* and *P. semisulcatus* was conducted in 7 ponds of various sizes (0.08-0.35 ha) at the marine fish farm of the institute at Mandapam Camp. Hatchery produced seeds of *P. monodon* were stocked in three ponds covering a total area of 0.75 ha. After 148 days, a total of 1,051 kg of shrimps were harvested. The size of shrimps ranged from 156 to 161 mm (27.8 to 32.3 g). Percent survival and food conversion ratio varied from 60 to 62% and 1.59 to 1.77,

respectively. Another batch of seed stocked in two ponds of total area, 0.67 ha were infected with white spot disease, 50 days after culture. The stocking rate, feeding, pond environment and water management in both situations were assessed and evaluated.

Developments in shrimp hatchery and farming

- 2.2 million hatchery produced postlarvae of the green tiger prawn *Penaeus semisulcatus* were searanched in the Gulf of Mannar.
- Induced maturation and breeding of *P. monodon* by artificial insemination technology standardised.
- Third generation of *P. monodon* seeds produced from domesticated broodstock.
- Experimental farming of *P. monodon* and *P. semisulcatus* showed higher net return from *P. monodon* farming.

Polyculture of *P. monodon*, *P. semisulcatus* and *P. indicus* was carried out to study the compatibility of the three species under pond conditions. A pond of 0.08 ha was stocked with 4708 hatchery produced seeds at a ratio of 8.3:6.4: 1. *P. monodon* alone was infected with white spot disease after 91 days of culture showing that it is more susceptible to white spot virus compared to *P. semisulcatus* and *P. indicus*.

Broodstock development of the tiger shrimp, *P. monodon* in captivity: Induced maturation and spawning of pond reared *P. monodon* by artificial insemination was successfully carried out. 18,000 seeds (PL_{17}) stocked in 0.15 ha pond during January 2000 had 'white spot' virus infection after 30 days of culture. The shrimps were fed on Ultrazyme-P-FS at the rate of 2 g/kg feed and were cultured further with improved water management for 88 days. 118 shrimps (58 males and 49 males) collected during the harvest were maintained in a 100 t tank and were fed on artificial diets fortified with Vitamin C, Vitamin E, fish oil and cod liver oil.

F_3 generation broodstock of *P. monodon* developed at Mandapam

After 156 days, females reached 208.6 mm /57 g and males 191 mm/56.3 g with an average survival rate of 47.5%. 18 females and 19 males were shifted to Visakhapatnam Research Centre to continue the studies and for the production of fast growing and disease free broodstock by selective breeding. Females and males, 9 each (Group I) of this stock are being maintained in one tank and the remaining 9 females and 4 males (Group II) collected

from the wild are kept together in another tank fitted with a recirculation system. The remaining 9 males are maintained separately. The third generation of seeds was produced from the first group and the postlarvae are being maintained for continuing the captive development of broodstock and for production of next generation of seeds.

PROJECT CODE	**CF/CUL/1.10**
PROJECT TITLE	**Broodstock development, seed production, farming and sea ranching of commercially important spiny and sand Lobsters**
SCIENTISTS	**E.V.Radhakrishnan,** M. Rajamani, K.K. Philippose, S. Lakshmi Pillai, Joe K. Kizhakudan and K.N. Saleela
CENTRES	Veraval, Calicut, Cochin, Vizhinjam, Tuticorin

Broodstock development, captive breeding and larval culture of the spiny lobsters, *Panulirus homarus, P. polyphagus* and *P. versicolor* were carried out at Calicut, Veraval, Vizhinjam and Tuticorin research centres.

Broodstock development and breeding of lobsters: At Calicut, juveniles of *P. homarus* grown in 10 t indoor tanks with self cleaning and flushing facility attained sexual maturity at a carapace length (CL) of 60 mm and began to breed on reaching an average of 70 mm CL and weight 325 g. These lobsters maintained in the indoor broodstock tanks with an average light intensity of 500 lux alone showed breeding activity, whereas those lobsters exposed to a light intensity of 15000 lux and above did not breed, indicating the need for lower light intensity for breeding activity of spiny lobsters. The peak breeding period of wild P. *homarus* off Calicut was from December to February, whereas the same in captivity was from June to July. During June, ten lobsters were obtained in berried condition from the broodstock tanks. Furthermore, breeding of *P. homarus* in captivity was observed almost throughout the year. The spermatophoric mass sticking on the sternal plate of females in captive broodstock was often found to fall off resulting in a single spawning within an intermoult period. In the wild, on the other hand, repetitive spawning of females within an intermoult period using the same spermatophoric mass was observed. The reasons for poor adhesive action of the spermatophore of captive male are to be investigated.

The quality of eggs (yolk colour, yolk content, egg size), fecundity and hatching rate of eggs of captive specimens were observed to be high, compared to eggs from breeders obtained from the wild. Two females of 69 and 72 mm CL which bred in captivity released 1,50,000 and 1,60,000 phyllosoma larvae, respectively which is 20% higher than wild lobsters.

Developments in lobster hatchery and farming

- Successful maturation and breeding of the spiny lobster Panulirus *homarus* was achieved by regulation of light intensity (500 lux) and on feeding with green mussel
- Delay in feeding of phyllosoma larvae by 24 hr after hatching resulted in delayed moulting and low survival.

Average fecundity of a wild *P. homarus* of this size is 1,25,000. Fecundity, egg quality and percent hatch of captive lobsters are higher than broodstock obtained from the wild. Feeding phyllosoma larvae with *Artemia* nauplii hatched out from infected cysts leads to protozoan infestation. Treatment of cysts with chlorine at 200 ppm for 10 minutes keeps the larvae free from infection. Breeder lobsters from the wild need antibiotic treatment before introducing into the broodstock tanks, failing which they may contaminate the larval rearing systems.

Comparison of captive and wild spawners of lobsters

- Fecundity of captive breeder is 20 % higher than wild breeder of the same size
- Percent of unfertilised eggs carried by captive breeder is only5 % of total eggs while in wild spawners it is 10 to 20 %
- Hatching percentage is 90 % in captive breeder while in wild spawners, transportation stress and exposure of eggs outside water reduce the hatch percentage
- Egg shedding is rare in captive spawners, while in wild spawners it is common
- Microbial infestation of eggs is low in captive spawners

At Veraval, *P. homarus* attained sexual maturity in captivity but failed to mate and breed, presumably due to limitation in tank space. Here, captive *P. homarus* required 12-20 days for rematuration and spawning or for moulting, whereas *P. polyphagus* was observed to remature and spawn within 5 days. Partially spawned females were observed to release a fresh batch of eggs in a short span of time compared to those lobsters that released the ova completely.

Larval rearing: Five larval rearing experiments were conducted using phyllosoma larvae released by captive broodstock. Phyllosoma larvae obtained from captive breeders were healthier and active. Larvae were stocked in rectangular (200 l) and cylindroconical FRP tanks with central drainage. Larvae fed with untreated *Artemia* nauplii were infected on the 5th day by stalked protozoan *Zoothamnium* sp which immobilizes the larvae by interfering in feeding and swimming and microsporidians which enter into the haemolymph and invades the whole circulatory system. *Artemia* nauplii obtained from chlorine treated cysts were not infected showing *Artemia* cysts are the source of infection. Larvae reared in sterilized seawater and fed on treated nauplii were free from any infestation and developed into stage IV in 30 days.

Development of protocol for treatment of infected larvae: Larvae infected with *Zoothamnium sp.* and microsporidia were exposed to 25 ppm, 50 ppm and 100 ppm formalin. Observation on activity of the parasite and larvae was made at 10-minute intervals. Long-term treatment with 25 ppm formalin for 4-5 hours is recommended and larvae were completely devoid of the external parasites. Concentration above 25 ppm was found to be lethal. Microsporidians require higher concentration of formalin, which affects the larval survival.

Effect of starvation and feeding regimes on survival, moulting and growth of phyllosoma larvae of the spiny lobster *P. homarus* : The effect of initial starvation and duration of feeding period on survival and growth of newly hatched phyllosoma larvae were studied and the results are given below:

Effect of starvation on phyllosoma larvae

Feeding initiation	Effect on larvae - day of moulting to Stage II
Completely starved	Survived only for 7 days
Immediately on hatching	6 th day
After 24 hrs	6 th day
After 48 hrs	9 th day; 30 % mortality in Stage II
After 72 hrs	10 th day; 30 % mortality in Stage II
After 96 hrs	10 th day; 80 % mortality in Stage II

Delayed feeding was found to delay moulting and reduce growth. Larval survival was, drastically affected by delayed feeding showing that feeding of larvae immediately after hatching or within 24 hours after hatching is essential for normal moulting, growth and survival of the larvae.

Lobster fattening : Experiments on farming and fattening of the spiny lobster *Panulirus homarus* was carried out in indoor grow out system at Calicut. Juvenile lobsters of average weight 89 g were stocked in 10 tonne capacity indoor grow out tanks and fed on green mussel. They attained an average weight of 325 g in the first year and 460 g in the second year. Experiments were also conducted on shorterm fattening. The concept of long-term lobster farming (2-3 months) i.e. growing undersized lobsters (<100g) to the preferred export size of above 200g has been shifted to either short term fattening for value addition or holding lobsters in indoor tanks until market demand is high to fetch the premium price. Lobsters are priced according to the weight and are graded commercially as <100 g, 100-200 g and >200g for 'greens' (*P. homarus, P. polyphagus* and *P. versicolor*) and <500 g, 500-1000 g, 1000-2500 g and >2500 g for 'tiger' (*P. ornatus*). The difference in export price between a lower grade and the next higher grade is nearly 125-150%. Therefore, short term fattening of a lower priced smaller grade to a higher priced larger grade is profitable. It has been estimated that 25-30 tonnes of juveniles (<100g) are landed along the southwest and east coast of India and until fishing regulations are enforced in restricting fishing juvenile lobsters, this low priced grade can be fattened profitably to get higher economic benefit. Further, lobsters with weight falling near the margin of a lower grade can be held in tanks and then fattened to the next higher grade with in a short growing period of 30-40 days.

PROJECT CODE CF/CUL/1.11
PROJECT TITLE Mariculture of crabs
SCIENTISTS **K.R.Manmadhan Nair,** Manpal Sridhar, N.K. Sanil, P.E.Sampson Manickam, Molly Varghese, Mirium Paul, S. Lakshmi Pillai, G. Maheswarudu, Josileen Jose, N. Kaliaperumal
CENTRES Cochin, Calicut, Mandapam, Visakhapatnam

Experiments were carried out on the rearing of mud crab Scylla *tranquebarica* and *Portunus pelagicus*. Three females and two males of *S. tranquebarica* were maintained in a rematuration tanks. The crabs were fed squid meat at 10% of their body weight. Two females spawned in the maturation tank after an incubation period 10-12 days and a total of 1.39 million zoeae I were released. 6.5 lakh zoeae I were stocked in the larval rearing tanks at

different stocking densities and fed with rotifer, *Artemia* nauplii and diatoms and the rest sea ranched. In two experiments total mortality of zoeae occurred. From two other experiments a total of 31 baby crabs were obtained and they were stocked in 10 ton tanks with recirculation system and reared for studying their rate of growh on a feed of squid meat. After 60 days a growth of the 84 mm C.W. and 90 gm weight were obtained.

Prof.(Dr) Mohan Joseph Modayil at Crab Harvest at Vallarpadam, Kerala

Four larval rearing experiments of *Portunus pelagicus* was conducted with berried females obtained from the wild. From 17 spawners a total of 4.9 million zoeae I were obtained out of which 9.54 lakh zoeae I were utilised for further rearing and 40,14,280 zoeae I were sea ranched. From these experiments 511 baby crabs were obtained and searanched. The crab zoeae were fed with *Chlorella*, rotifer and *Artemia* nauplii. Heavy mortality was observed in megalopa stage mainly due to cannibalism. The larvae metamorphose to baby crabs after twenty days. An experiment was carried out on the larval development of *Portunus sanguinolentus*. The zoea I, though lethargic, remained alive up to 10 days but failed to moult into n[illegible]ge and perished.

Experiments on developing suitable live feeds such as unicellular algae, diatoms, rotifers, cladocerans and caridian larvae and enriching these live feed with PUFA is also underway. An experiment on fattening/grow out culture of the mud crab *Syclla tranquebarica* has been initiated in a pond at KVK Narakkal.

Experimental farming of blue swimming crab *Portunus pelagicus* was conducted at Marine Fish Farm of R.C. of CMFRI at Mandapam. The crab seed produced in the backyard hatchery was used in this farming experiment. One 0.06 ha earthen pond was stocked with 1546 baby crabs. Different types of feed were given during different stages of growth of baby crabs. After 135 days the crabs were harvested. A total of 50 kg of (496 nos) crabs were harvested from this growout farming experiment. 85.75 kg of feed was consumed in this grow out experiment at an FCR of 1:1.72. The survival rate was 32.08%. The mean size at harvest were 117.6 mm/120 gm for males and 114.4 mm/103.2 g for females. The harvested crabs were sold for Rs.2000/- and amount was remitted to ICAR accounts.

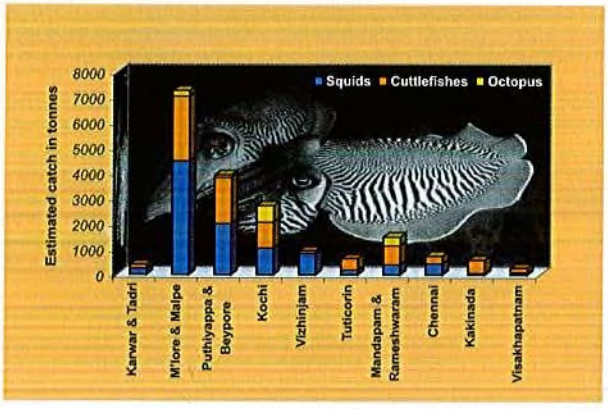
***Scylla tranquebarica:* baby crabs produced in the experimental hatchery at Mandapam.**

MOLLUSCAN FISHERIES DIVISION

The Molluscan Fisheries Division implemented research programmes on technology development for sea farming of marine molluscs and fishery biology of commercially important molluscs. The division has also given priority to transfer of bivalve farming technology to the end users which has resulted in the increased utilization of coastal ecosystem and employment generation.

PROJECT CODE	**MF/RE/1**
PROJECT TITLE	**Investigations on the resource characteristics of Cephalopods**
SCIENTISTS	**M.M. Meiyappan,** R. Sarvesan, K. Prabhakaran Nair, M.K. Anil, G. Syda Rao, A.C.C. Victor, V. Kripa, K.S. Mohamed, P.K. Asokan, Sujitha Thomas, Geeta Sasikumar, Boby Ignatius
CENTRES	Mangalore, Calicut, Cochin, Vizhinjam, Tuticorin, Mandapam, Chennai, Visakapatnam

The all India cephalopod production during 2000 was estimated as 1,11,523 t which is 21% more than that observed in 1999. Along the west coast centres, squids dominated the catch, except at Kochi, where squids and cuttlefishes were caught in almost equal proportions. Most of the catch was realised through operation of multiday trawlers in depths upto 100 m. Along the east coast, cuttlefishes dominated the catch at all centres except at Chennai, where squids were dominant. Octopods were observed only at Chennai, Mandapam and Rameswaram. There was a ban on fishing for 2-3 months along the west coast during monsoon period and during April -May along the Andhra Pradesh coast.



Groupwise Cephalopod catch at important Centres

Species Composition: Among squids, the neretic Indian squid *Loligo duvauceli* formed more than 75% of the catch at all centres except Mandapam and Rameswaram, where, the Palk Bay squid *Sepioteuthis lessoniana* formed more than 80% of the catch. *Doryteuthis* sp. formed more than 10% of the squid catch at Chennai and Kochi. Among cuttlefishes, *Sepia pharaonis* and *Sepia aculeata* formed the bulk of the catch at all centres followed by *Sepiella inermis*, *S. prashadi* and *S. elliptica*. At Kochi, *Octopus membranaceous* was the dominant species among octopods, followed by *O. dollfusi*.

Peak catch rates of cephalopods at west coast centres were observed during premonsoon and postmonsoon periods. At east coast centres, peak abundance was noticed during pre-monsoon and monsoon periods.

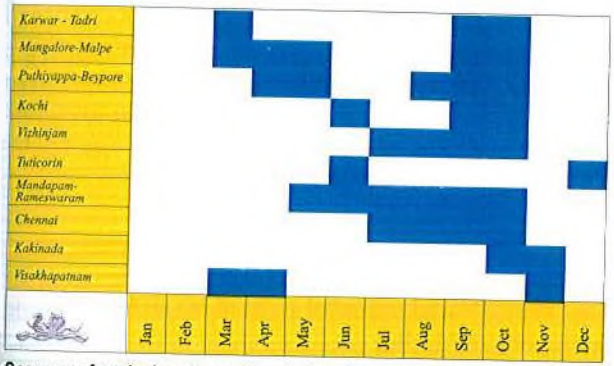
Biological Characteristics

Loligo duvauceli: The minimum and maximum sizes observed were 30 and 320 mm respectively. Multiple modes were

seen in all the months at all centres. The peak-breeding season was postmonsoon along the west coast, with a secondary peak during premonsoon at some centres. At Kochi, peak recruitment took place in February-March and September-October. The size distribution showed peak recruitment during April resulted from the peak spawning during northeast monsoon at Kakinada and Visakhapatnam.

Length range and peak breeding season of *L. duvauceli* during 2000

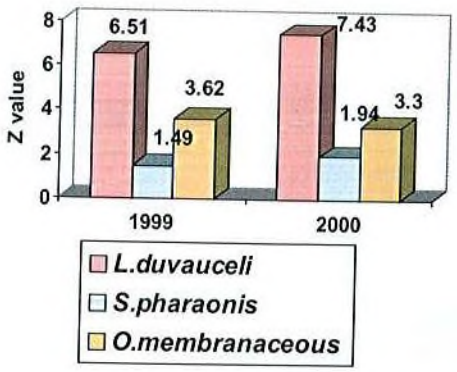
Centre	Sex	Length range (mm)	Peak breeding season
Mangalore & Malpe	Male Female	50-320 40-200	May, Nov-Dec
Puthiyappa & Beypore	Male Female	60-230 60-140	Sep-Dec
Chennai	Male Female	50-150 50-160	Throughout the year
Kakinada	Male & Female	30-150	Oct-Dec
Visakhapatnam	Male Female	40-140 50-140	Oct-Dec
Kochi	Male & Female	30-300	Feb-Mar, Sep-Oct



Seasons of peak abundance of cephalopods exploited at different centres

rates of *L. duvauceli*, *S. pharaonis* and *O. membranaceous* stocks exploited from Kochi were estimated with available growth parameters using the length converted catch curve. The exploitation rate of *L. duvauceli* was above the optimum, while cuttlefish and octopus stocks were under exploited during the current year. Comparison of Z values estimated during 1999 and 2000 shows that the Z values of *L. duvauceli* and *S. pharaonis* increased by 14 and 30%

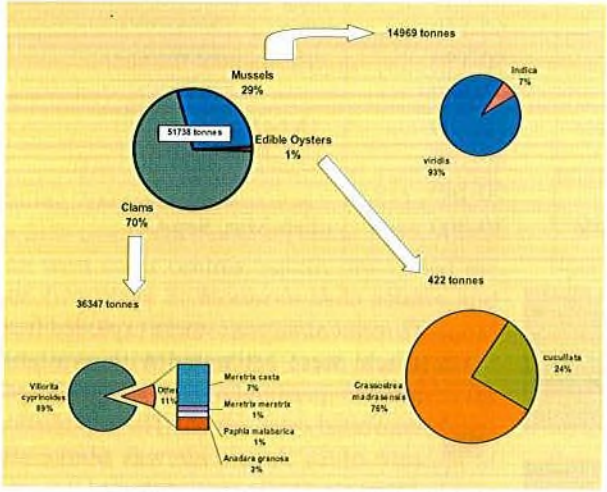
Sepia aculeata: Male cuttlefishes were dominant at Kakinada during March-April, July and October and females during January, February, June, August, September, November and December. Mature males were dominant in June and October-November and mature females during January, June, July, August and October-December. At Visakhapatnam, females outnumbered males and mature ones were dominant throughout the year.



Stock Dynamics: The annual total mortality

respectively. On the other hand the Z values of *O. membranaceous* decreased by 9%. The status of cephalopod stocks, especially squid and cuttlefish stocks need to be carefully monitored along the Kerala coast.

PROJECT CODE	**MF/RE/2**
PROJECT TITLE	**Investigations on the resource characteristics of bivalves and gastropods**
SCIENTISTS	**K. Ramadoss,** T.S. Velayudhan, V. Kripa, P. Laxmilatha, N. Ramachandran, P.V. Sreenivasan, R. Sarvesan, P. Natarajan, P.K. Asokan, Sujitha Thomas, Geeta Sasikumar, Boby Ignatius.
CENTRES	Mangalore, Calicut, Cochin, Vizhinjam, Mandapam Camp, Tuticorin, Chennai, Visakapatnam



Bivalve production (tonnes) during 2000 in Kerala, Karnataka & Andhra Pradesh

The bivalve and gastropod landings at the major centres along both the coasts were monitored. *Villorita cyprinoides, Meretrix casta, Meretrix meretrix, Paphia malabarica, Mercia opima* and *Anadara granosa* were the main species of clams fished and their production was estimated as 36,172 t. The annual landing of mussels, *Perna viridis* and *Perna indica*, from Kerala and Karnataka was estimated as 14,970 t, while edible oysters *viz. Crassostrea madrasensis* and *Saccostrea cucullata* production from these states was 422 t.

Average annual landing during 1995 – 99 and potential yield of bivalves and gastropods (all India)

Resource	Average annual landing (t) (1995-99)	Potential yield(t)
Edible oyster	18,800	33,962
Clams and cockles	1,10,687	1,16,277
Mussels	11,316	22,080
Windowpane oyster	9,300	12,278
Total Bivalves	1,50,103	1,84,597
Gastropods	23,343	20,760
Total Bivalves and Gastropods	1,73,446	2,05,357

The catch rate and effort for these groups showed seasonal and temporal variations. At Kakinada, clam picking was affected by a ban in 23,570 ha wild life sanctuary in Coringa and Bhimavapalem region by the Forest Department of Andhra Pradesh. The annual landings of chanks, *Xancus pyrum* by bottom set gill nets and trawl were estimated as 5.58 lakh numbers mainly from the south east coast. Apart from this, 555 t of other gastropods mainly *Hemifuses, Cerithidia*, and *Telescopium* sp. were landed at Kakinada.

Estimated bivalve biomass and species composition in certain estuaries of Kerala and Tamilnadu

State	Estuary	Estimated biomass (t)	Percentage composition			Species composition of clams
			Oyster	Mussel	Clam	
Tamil nadu & Pondichery	Muttukadu	5.6	81.7	-	18.3	Mc, Cm
	Vellar	1015	9.9	-	90.1	Mc, Mm, Mo, Ag ,Cm
	Chunnambaru	39.3	46.2	1.6	52.2	Mc, Mo, Ag, Pm,Cm, Pv
	Tengaithittu	143.2	29.9	28.3	41.8	Cm, Mc,Pv
	Alambaaru	135.6	94.6	2.6	2.8	Cm,Mc,Pv
Kerala	Chettuva	378	1.2	-	98.8	Vc, Mc

Ag – Anadara granosa, Cm – Crassostrea madrasensis, Mc- Meretrix casta, Mm – Meretrix meretrix, Mo – Mercia opima, Pm – Paphia malabarica, Pv – Perna viridis, Vc – Villorita cyprinoides

Based on the annual estimated landings of 1995 – 99 and the bivalve biomass estimated through different planned surveys along the coastal regions of maritime states, the potential yield of bivalves and gastropods was estimated as 2.05 lakh t. The species composition and bivalve biomass of some estuaries of Kerala, Tamilnadu and Pondicherry were estimated through planned short-term surveys. Since fishery of these resources was moderate in most of the estuaries, it is suggested that the fishing effort can be increased and utilization of these resources popularized to effectively use these bivalve stocks.

PROJECT CODE	**MF/CUL/4**
PROJECT TITLE	**Seed production and ranching of bivalve molluscs in coastal waters**
SCIENTISTS	**S. Dharmaraj**, K. Ramadoss, P. Muthiah, A. Chellam, P. Laxmilatha, Shoji Joseph and N. Ramachandran
CENTRES	Cochin, Vizhinjam, Tuticorin,

Seed production of the windowpane oyster *Placuna placenta* was successfully done for the first time in India. About 85 % of the seed produced was stocked in the Tuticorin Bay where an intense seasonal fishery was observed from 1999. Seed of commercially important

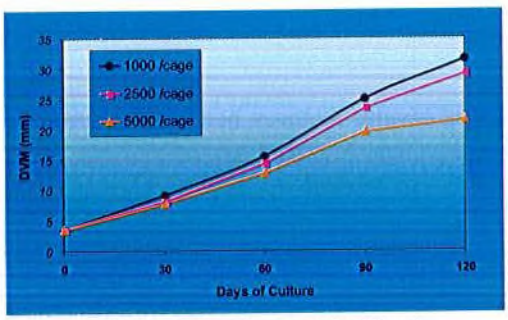
bivalves like *Pinctada fucata, Crassostrea madrasensis* and *Marcia opima* were produced in the shellfish hatchery at Tuticorin and utilized for mariculture and resource enhancement in natural beds of Tamilnadu.

Vizhinjam Bay, along the southwest coast was found to be a good centre for natural collection of spat of *Pinctada fucata* and *Perna indica*. The ideal period for setting spat collectors for the former was identified as January – February and for the latter, July-August. Pedestal and suspended iron framed cages and nylon frills were found to be good for spat collection. A new type of spat collector with laterally compressed synthetic fibre was fabricated and tested in the bay with good settlement rate.

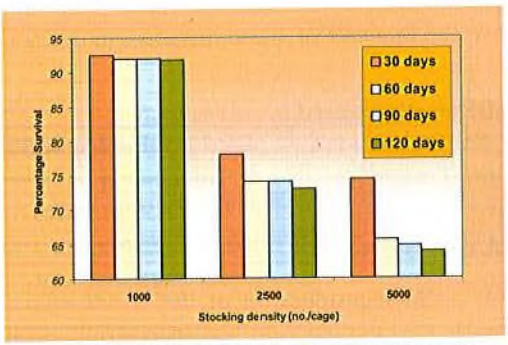
Hatchery-reared juveniles of the windowpane oyster, *Placuna placenta* at the Tuticorin Shellfish Hatchery.

Details of hatchery production of bivalve seed at Tuticorin

Species	Spat produced in the hatchery (Number)	Mean survival to spat (%)
Placuna placenta	2700	30.2
Crassostrea madrasensis	1,99,837	43.7
Pinctada fucata	2,25,000	36.3
Mercia opima	5,42,350	35.3



Growth of *P. fucata* in cages under different stocking densities at Mandapam



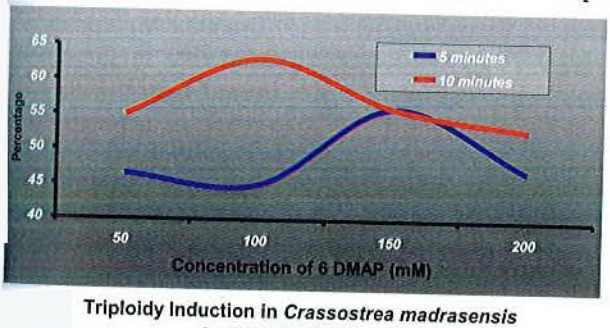
Survival rates of *Pinctada fucata* under different stocking densities at Mandapam

PROJECT CODE	**MF/CUL/8**
PROJECT TITLE	**Technological feasibility of bivalve culture at selected Centres**
SCIENTISTS	**R. Sarvesan**, P.V. Sreenivasan, P. Natarajan, G. Syda Rao, Geeta Sasikumar, P.K. Krishnakumar, K.Ramadoss and P.Muthiah
CENTRES	Mangalore, Tuticorin, Chennai, Visakapatnam

Demonstration of mussel farming was done along the Karnataka coast at three sites using two different types of growout structures. At Mulki and Sasihithulu, racks were constructed and mussel farming was demonstrated. The average growth rate of mussel at these sites ranged between 5 and 6 mm per month. At Bydoor a bamboo raft was fabricated with the involvement of fishers and seeded mussel ropes were suspended from this. Culture of *Crassostrea madrasensis* at Punnakayal, Tamilnadu and Bhimli backwaters in Andhra Pradesh gave information on the monthly growth increment and spat collection period. The study also indicated that for oyster farming, spat collecters can be set in the Bhimli backwater in June and the oysters reach harvestable size in 8 months. *Mercia opima* spat, 5 to 6 mm length, produced in the Tuticorin Shellfish Hatchery were stocked in the natural bed and their survival and growth rate are being monitored.

PROJECT CODE	**MF/CUL/9**
PROJECT TITLE	**Edible oyster culture**
SCIENTISTS	**K. Ramadoss** and P. Muthiah
CENTRES	Tuticorin

Triploidy was induced in *Crassostrea madrasensis* by using 6DMAP at different concentrations ranging 50 - 300 mM for 5 to 10 minutes, at temperatures 35° & 39° C for 5 & 10 min and 5 & 12 ° C for 10 & 20 min. Highest triploid induction of 63% was obtained in 100 mM treatment for 10 min. duration. More (42.8%) triploids were induced at 35° C treatment for 10 minutes. At 37° C, 5 minutes duration was more effective with 55.3% triploids. At 12° C with 20 minutes duration there was 44.7% triploids. On further rearing the triploid spat had registered a growth rate of 5.53 mm/ month (for 6 DMAP treated), 5.8 mm (for cold induced) and 5.5 mm for the control.



Triploidy Induction in *Crassostrea madrasensis* by 6 DMAP Treatment

PROJECT CODE	**MF/CUL/10**
PROJECT TITLE	**Upgradation and transfer of Pearl Culture Technology**
SCIENTISTS	**A.C.C. Victor,** A. Chellam, S. Dharmaraj, I. Jagadis and Boby Ignatius
CENTRES	Mandapam Camp, Tuticorin

Pearl oyster spat, mother oysters and nucleated oysters were reared in Gulf of Mannar and Palk Bay. Besides rack and raft, an experimental long line unit was fabricated and moored between two rafts at Mandapam. Cages made of rigid PVC pipes of 1" thickness, meshed

with synthetic twines were fabricated and stocked with pearl oysters to test the durability of rearing containers. Regular observations are made on the growth of oysters in these cages, fouling intensity and durability, which will form the database for working out the efficiency. An experiment to find the optimum stocking density in pearl oyster spat rearing was initiated by stocking in different densities, 1000, 2500 and 5000 nos/cage. Results indicated that stocking at 1000 nos/cage is better for higher survival and growth rate.

To compare the growth rate of pearl oyster, *Pinctada fucata*, along east and west coasts, hatchery produced spat from the same brood are reared at Tuticorin and Vizhinjam Bay. Preliminary observations indicated higher growth rate along the west coast. Similarly oysters from Vizhinjam Bay after nucleation are being farmed at Tuticorin.

PROJECT CODE	**MF/CUL/11**
PROJECT TITLE	**Popularization and transfer of bivalve culture technology at selected centres along Kerala Coast**
SCIENTISTS	**K.K. Appukuttan,** T.S. Velayudhan, V. Kripa, K.S. Mohamed, P. Laxmilatha, Shoji Joseph, P.K.Asokan, Sujitha Thomas, N. Ramachandran., V. Chandrika and Vipin Kumar
CENTRES	Calicut, Cochin, Vizhinjam

The best Model oyster farmer Award for the year 2000 presented to Shri Vincent Mukkadan by the Director, CMFRI

Transfer of technology through demonstrations was carried out and about 300 t of mussel and edible oyster were produced through farming. Development of mussel farming activities in the estuaries was at a faster pace than in the open sea. To demonstrate the high production rate in the open sea, farming programme was undertaken at Elathur with the active participation of the mussel pickers. A function was organized during the harvest by inviting officials from state fisheries and local governing bodies. Along Central Kerala two groups of fishermen continued mussel farming in the sea during this season also.

Production of edible bivalves through farming in Kerala and Karnataka

Site		Farm details	No.of farms	Species	Method	Production (kg)
North Kerala	Elathur	Demonstration	1	*Perna viridis*	Raft, open sea	1925
	Vallikunnu	Commercial	1	*Perna viridis*	Rack, estuary	800
	Padanna, Cheruvathur	Commercial	30	*Perna viridis*	Rack, estuary	3,00,000
Central Kerala	Chettuva	Commercial	1	*Perna viridis*	Rack, estuary	300
	Narakkal	Commercial	2	*Perna viridis*	Raft, open sea	2000
	Pallipuram	Experimental	1	*Perna viridis*	Rack, estuary	137
				Crassostrea madrasensis	Rack, estuary	135
South Kerala	Dalavapuram	Demonstration	1	*Perna viridis*	Rack, estuary	236
	Karunagapally	Commercial	6	*C.madrasensis*	Rack, estuary	500
	Chavara	Commercial	99	*C. madrasensis*	Rack, estuary	1000
	Paravur	Demonstration	1	*Perna viridis* *Perna indica*	Rack, estuary	139
Karnataka	Mulky	Demonstration	1	*Perna viridis*	Rack, estuary	1200
	Sashihithalu	Demonstration	1	*Perna viridis*	Rack, estuary	1300
Production of Mussels – 308 tonnes, Oysters – 1.6 tonnes						

In the estuaries of Kerala, mussel farming by Self-Help Groups (SHG) and other independent fishers was continued. These activities were monitored. Along with this new demonstration farms were set up and training on mussel farming was given to SHG women groups (65 trainees) in Kasargod, Cannanore and Calicut. Mussels cultured in the Kadalundi estuary at Vallikunnu by one of the trainees gave very high production rate of 22 kg/m rope. Mussel culture was also initiated in the Beeyam Kayal estuary at Ponnani by fishers with support from NGO. Oyster farming was introduced to several new areas of Ashtamudi and Kayamkulam Lakes of Kerala where more than 100 farms have come up. The financial support given @ Rs.1500 per unit of 500 rens and the technological feasibility were the main reasons for these large-scale activities.

Upgradation of mussel farming technology: Efficiency of materials other than 12 mm nylon rope was tested in the demonstration farm of the Institute at Dalavapuram in Ashtamudi Lake to reduce the capital investment in mussel farming. These were seeded at the same stocking density (1 kg/m) and the instantaneous relative growth rate (G) of the green mussel, *Perna viridis* in length and weight ($G = \ln L_1 - \ln L_0 / t \times 100$, where L_1 and L_0 are lengths after time (t) was compared. The results indicated that the rate of growth in length and weight were highest, 0.902 and 2.606% respectively in mussels seeded on the 12 mm nylon rope. The production rates indicated that 12mm nylon rope was the best performer in terms of growth rate and production. When the costs of input materials were compared, it was found that nylon rope is 12 times costlier than the plastic strip per meter of

Seeding of ropes during a training programme on mussel farming conducted at Puthuponnani

seeded length. Considering this it can be stated that plastic strips can be used as a more cost efficient seeding material in mussel culture. In addition to this bamboo/casuarina poles were replaced with concrete filled PVC poles to reduce recurring expenditure for farm maintenance. Pre-stiched cotton tubes were utilised for mussel to save on labour. Adopting these new refinements the additional gain as percentage of total income in a farm of 0.0025 ha works out to be 18.33 indicating that these can be recommended to the users.

The feasibility of integrated farming of oyster and mussels at Pallipuram, in Vypin island was demonstrated. About 139 and 137 kg shell-on oysters and mussels respectively were harvested. The average production of mussel was 9.2 kg per meter rope with 38.9% meat. Comparison of growth of brown, green and "parrot" mussels (having light green colour, possibly a hybrid of brown & green) at Ashtamudi Lake indicated that brown and 'parrot' are not suitable for culture in the estuarine system since they are not tolerant to salinity variations.

PROJECT CODE	**MF/CUL/12**
PROJECT TITLE	**Selective breeding of bivalves and evaluation of performance by farm trials**
SCIENTISTS	**T.S. Velayudhan,** V. Kripa, K.S. Mohamed, P. Laxmilatha, Shoji Joseph, C.P. Gopinathan, Sujitha Thomas, N. Ramachandran, P.Muthiah and P.C.Thomas
CENTRES	Calicut, Cochin, Vizhinjam,Tuticorin

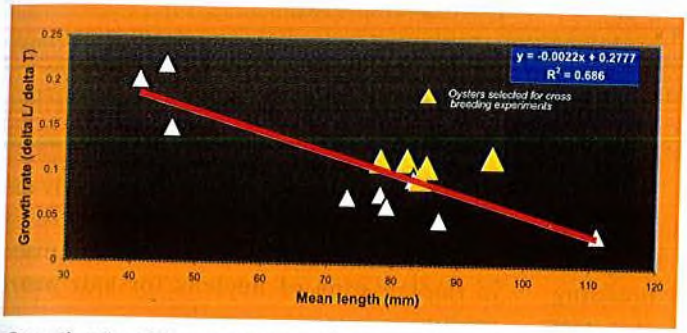
Oysters (*Crassostrea madrasensis)* from Ashtamudi Lake were reared individually in the farm for selecting oysters with superior growth characteristics. The mean ratio of change in length (ΔL) by change in time (ΔT) was also estimated as the growth rate of oysters in different mean lengths. The K and growth rate values were plotted against oyster mean lengths to arrive at a relationship.

Growth rate ($\Delta L/\Delta T$) = $-0.0022x + 0.2777$ ($R^2 = 0.686$)

Growth coefficent (K) = $-0.0235x + 4.2238$ ($R^2 = 0.588$)

The plots indicated that the growth rate and K values were high for smaller oysters and with increase in length both the values showed a declining trend. For cross breeding experiments, 6 oysters in reproductively active stages (mean length above 70 mm) having growth rate above 0.1 and K value above 1.5 were selected. These oysters are being conditioned for spawning and cross breeding experiments.

Selection experiments were continued in pearl oysters also. Several batches of pearl oyster



Growth rate of *Crassostrea madrasensis* at varying mean lengths at Dalawapuram Farm during 2000

broodstock were conditioned in the hatchery for breeding and the pearl oyster spat with green shell were identified for following the trait studies and subsequent selection. Oysters with more depth and good nacre coloration were selected to produce bigger pearls by implanting large nucleus.The hatchery produced pearl oyster spat with an average DVM of 28 mm stocked at Vizhinjam harbour farm showed a growth rate of 5mm/month . The *P. fucata* spat of average length 7.61mm transported from Tuticorin attained a length of 18.99 mm indicating a growth rate of 5.69mm/month.

PROJECT CODE	**MF/CUL/13**
PROJECT TITLE	**Culture of cephalopods**
SCIENTISTS	**A. Chellam,** G. Syda Rao, M.K. Anil
CENTRES	Vizhinjam, Tuticorin, Vishakapatnam

During this year, at Tuticorin, F5, F6 and F7 generations of the cuttlefish *Sepiella inermis* were successfully maintained and sea ranched. Variations were noted in the egg deposition period, no.of eggs laid and the survival period in these three generations.

Details of F4 –F6 generations of *Sepiella inermis* reared in the hatchery

Particulars	Generation reared in the hatchery		
	F4	F5	F6
Days for attaining maturity	80	107	110
Number of viable eggs	1259	766	655
Mean length (mm)	63.3	75.8	88.6
Mean Weight (gm)	54	34	78
Life span (days) in laboratory	115	148	204

Apart from this, fresh broodstock was brought from wild and maintained for breeding studies. Farming experiments were started by stocking hatchery-produced young ones in hapas of nylon mesh in Tuticorin Bay. However complete mortality occurred within 10 days of stocking.

PROJECT CODE	**MF/CUL/14**
PROJECT TITLE	**Seed production and pearl culture in the abalone *Haliotis varia***
SCIENTISTS	**A.C.C. Victor,** A. Chellam, I. Jagadis, Boby Ignatius
CENTRES	Mandapam Camp, Tuticorin

Abalones were collected from the Tuticorin Harbour basin and Krusadai Island at regular intervals and their gonadal maturity was observed for standardization of breeding experiments. The spawning response was poor and experiment is being continued. Experiments are also designed and implemented to study the gonadal development of abalones by placing them in rearing cages in natural beds. Trials made in implantation of nucleus for half pearl production were not successful.

PROJECT CODE	**MF/CUL/15**
PROJECT TITLE	**Standardization of techniques in onshore pearl culture**
SCIENTISTS	**G. Syda Rao** and K. Vijayakumaran
CENTRES	Vishakapatnam

It was observed that spat (5 mm) will reach implantable size (50 mm, 10 to 12 g) in six months. Survival rate was 80% during this rearing period. They are fed with *Chaetoceros, Isochrysis* and *Nanochloropsis* at a suitable ratio and at desired concentrations with respect to size and season. The feed species, schedules and concentrations were standardized. Pearls of 3 to 5 mm can be harvested in 6 months after their implantation with a minimum 25% yield over the implanted oysters. Broodstock of pearl oyster *Pinctada fucata* are maintained in a ready to spawn stage. This brood stock technology has been filed through the IPR cell of ICAR. Experiments conducted to study the influence of temperature over the growth indicated that best growth is achieved between 22 and 35 ^{0}C, under standard onshore feeding conditions.

PROJECT CODE	**MF/CUL/16**
PROJECT TITLE	**Development of lowcost technology system for sea farming of pearls and mussels**
SCIENTISTS	**G.P.K.Achary,** N. Ramachandran, Rani Mary George, M.K. Anil and Said Koya
CENTRES	Cochin, Vizhinjam

The brown mussel *Perna indica* and the pearl oyster *Pinctada fucata* obtained from earlier settlements were grown and used as spawning stock in Vizhinjam Bay. The mussels collected on spat settlers (loosened nylon rope) were grown on the same material without thinning and they reached 7-8 cm at the end of one year from settlement. Although the growth was good, survival was very poor. Therefore traditional method of mussel culture was done and seeded mussel ropes were suspended from the raft.

About 10,000 adult pearl oysters including the 1500 young ones (2.8 cm mean length) brought from Tuticorin were stocked in cages and suspended from the raft. The growth rate observed was 0.5 cm/month. Spat settlement

season started by the end of December and pearl oyster spat were found attached on the nylon net covering of plastic cages. Different types of collectors were also kept suspended for spat settlement. Techniques for transportation of adult oysters in wet packing systems without any significant mortality were standardized. By using plastic basket type cages instead of iron framed cages for growing pearl oysters, the cost of cage was reduced to Rs.50/- per piece.

FISHERY ENVIRONMENT MANAGEMENT DIVISION

The Division conducted research to achieve the targets in environmental monitoring, conservation and farming of sea cucumber and seaweeds through 9 Institute projects, 7 funded projects, 1 NATP and 1 Revolving fund project. In addition to this 4 consultancy programmes related to environment were also implemented.

PROJECT CODE	**FEM/ES/1**
PROJECT TITLE	**Investigations on environmental parameters of inshore waters in relation to fisheries**
SCIENTISTS	**C.P.Gopinathan,** S.Muthusamy, T.S. Naomi, V.V. Singh, P.K.Krishnakumar, Rani Mary George, M.Rajagopalan, K.Vijayakumaran and P.T. Sarada
CENTRES	Mumbai, Mangalore, Cochin, Vizhinjam, Mandapam Camp, Tuticorin, Chennai, Visakhapatnam, Minicoy

The variations in the environmental parameters of the inshore and coastal waters were monitored from 6 stations along the west coast and from 4 stations along the east coast. The sea surface temperature (SST), salinity, dissolved Oxygen and nutrients such as nitrites, nitrates, phosphates and silicates showed wide variations. It was observed that SST was maximum at Karwar and Bombay waters (32.0 °C) and minimum(23.8 °C) at Visakhapatnam. High salinity values (> 35‰) were recorded at Minicoy, Bombay, Tuticorin and Vizhinjam and low (< 10‰) at Cochin and Calicut. The dissolved oxygen was high at Minicoy, Vizhinjam, Mandapam and Madras while very low values prevailed in the Cochin, Calicut, Karwar and Mumbai coastal waters. There were no significant variations in the dissolved nutrient levels. The primary production rates were high at Cochin, Karwar, Tuticorin and Madras and low at Calicut and Mangalore. Zooplankton biomass was moderate to high at Cochin and Mangalore and low at Tuticorin.

Range of different hydrographic parameters at selected centres along the Indian coast during 2000

Centre	SST (°C)	Salin -ity (ppt)	DO (ml/l)	Nutrients (µg/at/l)				Pri. Prod. (mg C/m³/ day)	Sec.Prod. (ml/10m³)
				No_2^-	No_3^-	Po_4^-	Sio_3^-		
Cochin	22.4-30.3	7.58-35.29	0.68-5.33	0.02-3.34	Tr-1.2	0.14-4.06	2.28-47.12	Post mon: >100 Monsoon: > 50 Pre-mon : < 30	1- 18.96
Calicut	27.0-30.2	0.3-35.0	2.49-3.85	-	-	-	-	125.7-737.8 (NPP)	-
Mangalore	27.3-31.0	-	4.43-5.12	0.6-3.07	-	0.74-1.42	11.0-16.01	0.301-0.744 (Chl a) (mg/m³)	10m : 31.5 20m : 25.7
Karwar	25.5-32.0	7.84-33.74	2.01-4.81	-	-	-	-	220.5-1011.9 (GPP)	-

Mumbai	26.5-32.0	17.78-35.57	1.85-5.77	0.86-3.55	0.44-7.04	1.78-11.89	28.29-57.23	0.81-16.86 (Chl a) (mg/m^3)	-
Minicoy	27.0-29.0	27.4-35.9	3.4-6.2	0.5-1.3	0.4-1.6	0.7-3.4	0.7-3.7	7.4-113.06(GPP) 0-19.61 (NPP)	-
Vizhinjam	25.7-29.8	33.01-35.4	2.59-6.1	-	-	-	-	-	-
Tuticorin	25.0-29.8	29.8-40.17	2.49-5.71	-	-	-	-	41.8- 2274 (GPP)	2 - 7.6
Mandapam	25.2-31.8	28.08-35.0	3.42-6.95	0.5-2.0	0.01-1.75	0.03-0.24	1.5-20.1	28.9-276.8(GPP) 14.49-123 (NPP)	-
Chennai	25.0-30.0	19.0-35.0	2.8-6.1	Tr-0.5	Tr-25.0	Tr-0.75	-	343- 2060 (GPP) 50-1960 (NPP)	-
Visakha-patnam	23.8-29.5	28.0-33.28	5.5-7.1	Tr-0.045	-	0.016-0.094	0.185-2.86	-	-

Tr - Traces

PROJECT CODE FEM/ES/6

PROJECT TITLE **Ecological investigations on the inter-tidal and surf zones of the Kerala and Kanyakumari coasts in relation to finfish and shellfish seed and juvenile resources**

SCIENTISTS **G.S. Daniel Selvaraj**, Molly Varghese, S.Krishna Pillai, S. Jasmine and Gulshad Mohammed

CENTRES Calicut, Cochin, Vizhinjam

The annual rainfall during 2000 declined compared to the previous year. The effect was greater in the surf zone than in the backwater system. Phosphate and primary productivity appeared to have relationship with the onset and closure of the SW monsoon along the coast. Nitrite and nitrate values were low in the surf zone during the SW monsoon and post monsoon period.

Annual average values of estimated gross primary production revealed that the surf zone off Kozhikode was more productive (1.290g C/ m^3/d) than that off Kochi (1.039 g C/m^3/d). The highest productivity value was observed in October. The decline in the NE monsoon rainfall led to the increase in salinity in the intertidal zone during Oct-Dec, which could be related to the abundance of juveniles of fishes such as *Ambassis gymnocephalus, Leiognathus brevirostris, Johnius osseus* and *Kowala coval* in Cochin backwater. Juveniles of *Etroplus suratensis, E. maculatus* and gobiids were more abundant in the backwater during SW monsoon months when the salinity was less than 5 ppt. Juveniles of *Thrissocles malabaricus, T. mystax, Gerres abreviatus, Caranx kalla, Stolephorus macrops* and *Liza* spp. were recorded throughout the year in the same area. Juveniles of *Etroplus*

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Centre	SST (°C)	Salin -ity (ppt)	DO (ml/l)	Nutrients (µg/at/l)				Pri. Prod. (mg C/m³/ day)	Sec.Prod. (ml/10m³)
				No_2^-	No_3^-	Po_4^-	Sio_3^-		
Cochin	22.4-30.3	7.58-35.29	0.68-5.33	0.02-3.34	Tr-1.2	0.14-4.06	2.28-47.12	Post mon: >100 Monsoon: > 50 Pre-mon : < 30	1- 18.96
Calicut	27.0-30.2	0.3-35.0	2.49-3.85	-	-	-	-	125.7-737.8 (NPP)	-
Mangalore	27.3-31.0	-	4.43-5.12	0.6-3.07	-	0.74-1.42	11.0-16.01	0.301-0.744 (Chl a) (mg/m³)	10m : 31.5 20m : 25.7
Karwar	25.5-32.0	7.84-33.74	2.01-4.81	-	-	-	-	220.5-1011.9 (GPP)	-

Mumbai	26.5-32.0	17.78-35.57	1.85-5.77	0.86-3.55	0.44-7.04	1.78-11.89	28.29-57.23	0.81-16.86 (Chl a) (mg/m^3)	-
Minicoy	27.0-29.0	27.4-35.9	3.4-6.2	0.5-1.3	0.4-1.6	0.7-3.4	0.7-3.7	7.4-113.06(GPP) 0-19.61 (NPP)	-
Vizhinjam	25.7-29.8	33.01-35.4	2.59-6.1	-	-	-	-	-	-
Tuticorin	25.0-29.8	29.8-40.17	2.49-5.71	-	-	-	-	41.8- 2274 (GPP)	2 - 7.6
Mandapam	25.2-31.8	28.08-35.0	3.42-6.95	0.5-2.0	0.01-1.75	0.03-0.24	1.5-20.1	28.9-276.8(GPP) 14.49-123 (NPP)	-
Chennai	25.0-30.0	19.0-35.0	2.8-6.1	Tr-0.5	Tr-25.0	Tr-0.75	-	343- 2060 (GPP) 50-1960 (NPP)	-
Visakha-patnam	23.8-29.5	28.0-33.28	5.5-7.1	Tr-0.045	-	0.016-0.094	0.185-2.86	-	-

Tr - Traces

PROJECT CODE FEM/ES/6

PROJECT TITLE **Ecological investigations on the inter-tidal and surf zones of the Kerala and Kanyakumari coasts in relation to finfish and shellfish seed and juvenile resources**

SCIENTISTS **G.S. Daniel Selvaraj**, Molly Varghese, S.Krishna Pillai, S. Jasmine and Gulshad Mohammed

CENTRES Calicut, Cochin, Vizhinjam

The annual rainfall during 2000 declined compared to the previous year. The effect was greater in the surf zone than in the backwater system. Phosphate and primary productivity appeared to have relationship with the onset and closure of the SW monsoon along the coast. Nitrite and nitrate values were low in the surf zone during the SW monsoon and post monsoon period.

Annual average values of estimated gross primary production revealed that the surf zone off Kozhikode was more productive (1.290g C/m^3/d) than that off Kochi (1.039 g C/m^3/d). The highest productivity value was observed in October. The decline in the NE monsoon rainfall led to the increase in salinity in the intertidal zone during Oct-Dec, which could be related to the abundance of juveniles of fishes such as *Ambassis gymnocephalus, Leiognathus brevirostris, Johnius osseus* and *Kowala coval* in Cochin backwater. Juveniles of *Etroplus suratensis, E. maculatus* and gobiids were more abundant in the backwater during SW monsoon months when the salinity was less than 5 ppt. Juveniles of *Thrissocles malabaricus, T. mystax, Gerres abreviatus, Caranx kalla, Stolephorus macrops* and *Liza* spp. were recorded throughout the year in the same area. Juveniles of *Etroplus*

Quarterly mean values of hydrographic parameters from the surf zone and the backwaters around Kochi.

Parameter	Jan - March		Apr - June		July - Sept		Oct - Dec	
	Surf.	Back-water	Surf.	Back-water	Surf.	Back-water	Surf.	Back-water
Seawater temp (°C)	29.2	29.6	28.3	29.5	26.1	28.4	28.9	29.7
Salinity (ppt)	32.33	24.59	28.21	13.05	26.22	8.27	33.25	13.63
Diss.Oxygen (ml/l)	4.05	3.34	4.01	3.57	3.72	3.77	4.07	4.08
Phosphate (µg at/l)	1.97	2.03	2.53	2.91	3.38	3.11	1.05	1.27
Nitrite (µg at/l)	1.63	1.67	1.01	3.99	0.58	0.61	0.32	0.41
Nitrate (µg at/l)	1.43	3.59	0.92	2.54	0.54	1.36	0.10	0.17
G.P.P. (g.C/m³/d)	0.566	0.332	0.909	0.649	1.054	0.547	1.627	1.373
N.P.P. (g.C/m³/d)	0.453	0.266	0.727	0.519	0.843	0.438	1.302	1.098
Total rainfall (mm)	236		858		1030		338	

spp., and *Therapon* spp. were present throughout the year in the estuarine systems of Trivandrum and Kanyakumari districts. Among prawns, juveniles of *Metapenaeus dobsoni* were available throughout the year as in the previous year. Early juveniles of *Penaeus indicus* were considerably more close to the commencement of SW monsoon while those of *M. dobsoni* and *M. monoceros* were more during SW monsoon months in the backwaters. Abundance of early juveniles indicate their period of peak recruitment in the fishery of inshore waters.

Relative abundance (%) of juvenile fishes and prawns in the intertidal estuarine zone at Kochi

Fishes / Prawns	Jan -Mar	Apr -June	July-Sept	Oct -Dec
No. of fishes analysed	**435**	**500**	**338**	**334**
Ambassis spp.	40.2	6.2	17.4	43.4
Etroplus spp.	0.2	25.0	25.4	2.7
Caranx spp.	1.4	1.6	1.5	0.6
Gerres spp.	1.6	0.6	7.3	0.9
Stolephorus spp.	16.6	19.6	15.2	3.6
Thrissocles spp.	5.5	3.0	2.2	3.0
Leiognathus spp.	10.6	14.4	13.0	29.6
Liza spp.	3.5	1.0	8.0	0.3
Johnius spp.	10.6	16.4	Nil	12.0
Gobius spp.	2.1	4.4	8.0	0.9
Kowala coval	4.4	Nil	0.7	3.0
Others	3.3	7.8	1.3	Nil
No. of prawns analysed	**741**	**617**	**686**	**781**
M. dobsoni	98.5	40.8	85.0	68.8
M. monoceros	0.4	29.7	8.6	1.9
P.indicus	0.1	29.0	Nil	0.4
Other penaeids	Nil	Nil	Nil	0.1
Non-penaeids	1.0	0.5	6.4	28.8

In the surf zone around Kochi, decapod larvae were abundant during first quarter, molluscan larvae during second quarter and fish eggs and larvae during last quarter of the year with peaks during February (767 nos./100 m^3), May (433 nos./100 m^3) and October (1400 nos./ 100 m^3) respectively. The data on decapod larvae and fish eggs and larvae in the previous year showed their abundance in the third quarter with peaks during July (1700 nos./100 m^3) and September (5500 nos. / 100 m^3) respectively.

PROJECT CODE	**FEM/LF/1**
PROJECT TITLE	**Mariculture of live feed organisms**
SCIENTISTS	**K.G. Girijavallabhan**, C.P. Gopinathan, P. Kaladharan,T.S. Naomi, Rani Mary George, S.Jasmine, Molly Varghese, Reeta Jayasankar, M.Rajagopalan, P.T. Sarada, K.Vijayakumaran and D.Kandasamy
CENTRES	Cochin, Vizhinjam, Mandapam Camp, Tuticorin, Chennai, Vishakapatnam, Minicoy

Mass cultures of micro algae *Isochrysis, Tetraselmis, Dunaliella, Nannochloropsis, Chlorella* and *Chaetoceros* were developed and provided for the larval rearing of crustaceans, molluscs and finfishes in the Institute. Pure stock cultures were maintained and made available to commercial shrimp hatcheries. At Cochin, blue green algae such as *Synechocystis salina* and *Spirulina fusiformis* (freshwater) were also maintained. Zooplankters such as rotifers (*Brachionus* sp.), cladocerans (*Moina* sp) and copepods (*Euterpina* sp, *Oithora* sp and *Tigriopus* sp.) were also maintained. At Vizhinjam the harpacticoid copepod, *Euterpina acutifrons* was isolated and reared in the laboratory as a new source of live feed for marine finfish larvae. The project initiated work on the following new areas.

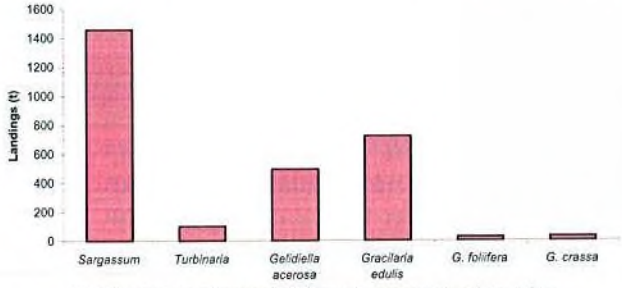
1. Cryo-preservation of *Chlorella* and *Nannochloropsis*
2. Pure culture of the copepod *Oithora rigida*
3. Use of seaweed extract (*Ulva fasciata)* as a replacement for vitamins for the mass culture of *Tetraselmis gracilis* .
4. Phototrophic sulfur bacteria produced in the laboratory for feeding *rotifer*, *moina* and *Artemia* strains instead of microalgae.

PROJECT CODE	**FEM/SW/1**
PROJECT TITLE	**Seaweed investigations –Resource Assessment of seaweeds and their culture**
SCIENTISTS	**N.Kaliaperumal**, P.Kaladharan, Reeta Jayasankar and Gulshad Mohammed
CENTRES	Calicut, Cochin, Mandapam.

The experiments on culture of *Gracilaria edulis* in FRP tanks in the green house at Mandapam, after a 12 h pretreatment of seed material with different concentrations of NPK, Super phosphate and di–ammonium phosphate revealed the following highest increase of biomass.

- 300 % increase in 32 days with NPK at 20mg/l
- 140 % increase in 42 days with super phospahate at 40mg/l
- 180 % increase in 36 days with di – ammonium phospahate at 40mg/l.

Polyculture of *Gracilaria edulis* with groupers in the onshore cement tank at



Estimated landings of different seaweeds along the Tamilnadu coast during 2000

Mandapam exhibited 42.3% increase in biomass within 13 days. Culture of *Gracilaria edulis* in the open sea off Narakkal by introducing the vegetative fragments in nylon net bags, registered 17% increase in biomass after 28 days. *Gracilaria edulis* was also cultured using spores in different culture sites at Cochin and Mandapam. The spores grew to harvestable size plants only in the nearshore area of Narakkal. The total quantity of seaweeds landed at 12 seaweed landing centers along Tamil Nadu was estimated as 2818 tonnes on dry weight basis.

PROJECT CODE	**FEM/MP/1**
PROJECT TITLE	**Monitoring the state of health of coastal waters in relation to pollution and aquaculture**
SCIENTISTS	**P.K. Krishnakumar,** M. Rajagopalan, George. J.P., P. Kaladharan, D. Prema, D.C.V.Easterson, P.S. Asha, and S.Krishna Pillai
CENTRES	Mangalore, Cochin, Vizhinjam,Tuticorin, Chennai

Along the Karnataka coast, the impact of effluent discharge from an oil refinery into the coastal waters off Chithrapur (Mangalore), was monitored. Significant changes did not take place in seawater quality (TSS, BOD, Sulphide, oil, grease etc), chlorophyll *a* content, zooplankton biomass and benthic biomass near the effluent discharge point (marine outfall) of the oil refinery, compared to a reference site. Accumulation of toxic heavy metals such as Cd, Pb, Cu and Zn in zooplankton and fishes collected from the effluent discharge point was within the permissible limits. Tissue concentration of Cadmium in demersal fishes varied from 0.13 to 0.51 ppm. Moderate quantities of tar balls (oil residues), 10-25 g/m^2 were observed on the beaches of Dakshina Kannada and Uduppi Districts, starting from Thannirbavi to Malpe (coast line length of 60-75 km) during the second week of April 2000.

Along Kerala coast, relatively higher values of Cd, Pb, Zn, organic carbon and pH were recorded in the sediment of inshore than the estuarine regions. However, concentration of Cu was high in sediment samples taken from the estuary compared to inshore waters. High concentrations of Zn, Pb and Cu were recorded during January and Cd in July. Total humic acid (THA) content in seawater and sediment were studied because THA are natural chelators that can bind with toxic metals. The annual mean value of THA in surface water was less (0.752 µg/l) compared to the mean value recorded for bottom water (2.11 µg/l).

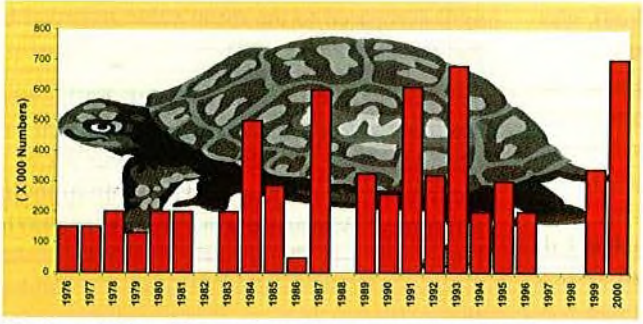
Small quantities of tar balls were observed on beaches at Kaipamangalam and Chavakkad in October and at Purakkad in December. Beaches at Thrikunnappuzha, Alleppey, Mararikulam, Anthakaranazhi, Puthuvypu and Cherai were free from tar ball contamination during October-December. Relatively large tar blocks (not balls) weighing 200-300 g were observed on the beach at Thumba in November and at Valiathura during December.

Along the Tamilnadu coast, significant changes were not observed in seawater quality (temperature, salinity, dissolved oxygen content, nutrients etc.) from Ennore estuary and near Kasimedu Fishing Harbour. Concentration of heavy metals (Pb, Mn and Cu) in seawater was relatively high at Ennore estuary compared to Ennore sea. Metals (Cu, Zn, Cd and Hg) were below the detection limit at both the sites. At Tuticorin, very low dissolved oxygen value of 0.10 ml/l was observed at the fly ash laden station near the Hare Island during December. The average annual mercury concentration in seawater away from the marine outfall of a chemical plant was 2.53 µg/l while, in the lagoon (Lagoon NP) near the marine outfall was 4.74

µg/l. Mercury concentration in the lagoon (Lagoon NP) near the marine outfall of the chemical plant at Kayalpattinam was high, compared to the values recorded from other stations. Monitoring of tar ball (oil residue) contamination on beaches from Valinokkam, near Tuticorin was carried out. Tar ball deposition was recorded during December on the beaches at Valinokkam near a ship-breaking site.

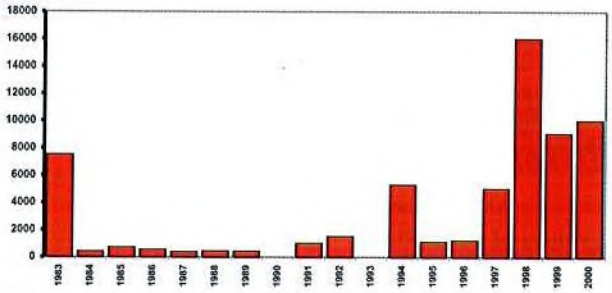
PROJECT CODE	FEM/MT/1
PROJECT TITLE	Conservation of Marine Turtles
SCIENTISTS	**M. Rajagopalan** and S. Krishna Pillai
CENTRES	Vizhinjam, Chennai

During 2000, a total of seven lakhs of olive ridley (*Lepidochelys olivacea*) nested in March along Gahirmatha, Rushikulya and Devi River mouth area, Orissa, as against 3.4 lakhs of nesting during 1999. The mass nesting was a failure during 1997 and 1998 season. The analysis of 25 years data from 1976 to 2000 revealed that the annual number of olive ridley nesting along the Gahirmatha coast, exceeded 0.5 million during 1984, 1987, 1991, 1993 and 2000. The nesting ranged between 0.1 and 0.5 million during 15 years. There was no mass nesting during 1982, 1988, 1997 and 1998. This trend in the number of nesting does not indicate perceptible increase or decline in the nesting population over the years.Along the coastal districts of Balasore, Cuttack, Puri and Ganjam of Orissa about 10,000 turtles were incidentally caught by fishing gears during 2000, when compared to 9047 in 1999. The incidental catch was higher during 1997, 1999 and 2000 along Orissa coast.



Number of Olive ridly nestings along the Gahirmatha coast, Orissa.

Among the five species of marine turtles olive ridley *L.olivacea* (295 nos) and leatherback *D.coriacea* (2 nos) were noticed in the incidental catches in fishing gears at Vizhinjam. 297 turtles were noticed in the incidental catch during 2000 when compared to 510 in 1999. Gill nets and hook and lines were responsible for the mortality of turtles. In the mortality of olive ridley 66% were females and 34% males. Higher mortality (44%) was observed in January followed by February (32%) and March (24%). The carapace length (curved) of olive ridley ranged from 40.5 cm to 69 cm and weight varied from 19 to 60 kg.



Estimated number of Olive ridley stranded along Gahirmatha beach.

PROJECT CODE	**FEM/AR/1**
PROJECT TITLE	**Biodiversity studies**
SCIENTISTS	**P.A. Thomas**
CENTRES	Vizhinjam

About 261 specimens of sponges/ gorgonids/alcyonarians collected from Orissa Tamilnadu, Kerala and Maharashtra were identified and the data provided to National Institutions and Universities for investigations on marine drugs. This was also utilized in the DOD project 'Drugs from the seas' co-ordinated by the CDRI, Lucknow.

Details of sponges, gorgonids, alcyonarians identified

Locality	Institution	Resource identified			Total
		Sponges	Gorgonids	Alcyonarians	
Mandapam	IICT, Hyderabad	45	-	-	45
Mandapam	NIO, Goa	38	4	-	42
Mandapam	CDRI,Lucknow	10	-	-	10
Tuticorin	Andhra University	36	3	1	40
Orissa coast	RRL,Bhubhaneshwar	63	47	-	109
Vizhinjam	CMFRI	7	-	-	7
Cape Comorin	CMFRI	6	-	1	7
Agra	Agra University	1	-	-	1
Total		**205**	**54**	**2**	**261**

Sponges from Cape Comorin area and from mussel culture farms were also identified. Some of these sponges collected from the mussel raft showed a tendency to overgrow mussels causing considerable obstruction or even mortality to the latter. Attempts were made to study the Alcyonarian genera *Sinularia*, *Sarcophyton* and *Lobophytum* as the species under these genera constitute the main bulk of the Order Alcyonacea. Details on the symbionts, both cortical and chanosomal, arenaceous inclusions etc were studied as these informations are helpful in tracing the origin of certain peculiar chemical compounds in sponges.

PROJECT CODE	**FEM/HOL/1**
PROJECT TITLE	**Breeding, seed production and sea ranching of sea cucumber, *Holothuria scabra***
SCIENTISTS	**P.S. Asha**
CENTRES	Tuticorin

Out of 20,000 larvae of *Holothuria scabra* produced, 10% reached upto doliolaria stage while others died of ciliate infestation. Broodstock of *H.scabra* maintained in the laboratory was found to develop skin lesions leading to mortality. Pathological studies on the development of skin lesions in the brood stock of *H.scabra* indicated the presence of *Streptococcus* sp. (100,000 CFU/ml) and were found to be sensitive to Chloramphenicol and Tobromycin in the sensitivity test. However, spawning of *H.scabra* revived again to some extent when the sand of the brood stock tank was changed. When the auricularia larvae were reared in filtered seawater and fed by *Isochrysis galbana*, 20% of larvae attained 1.1 mm length and 0.9 mm breadth on the 13th day when the water temperature and salinity were maintained at 24-26° C and 33-35 ppt respectively. They survived upto 30 days without undergoing metamorphosis. Similar experiments conducted on *H.spinifera* indicated that the size of late auricularia stage of this species was less than that of *H.scabra*. The larvae of *H.spinifera* were alive for 18 days without undergoing metamorphosis and died. In another experiment conducted by suspension of sperm *H.cineracens*, trochophore larvae settled to the bottom of the tank after five days and the auricularia larvae survived for 20 days attaining a maximum length of 1.1 mm.

Experiments conducted on asexual reproduction in *H.atra* and *H.leucospilota* by applying silicon rubber band on the mid body showed that the posterior pieces of *H.leucospilota* showed better survival rate.

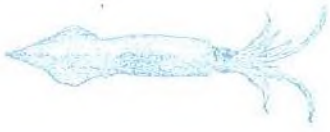
PROJECT CODE	**FEM/MB/1**
PROJECT TITLE	**Sanitary significance of faecal coliforms in selected coastal environments growing marine shellfishes**
SCIENTISTS	**V. Chandrika**
CENTRES	Cochin

Seasonal distribution of bacterial parameters of faecal pollution of Dalawapuram shell-fish farm-site like Total Plate Count (TPC), Total coliform *Escherichia coli*, *Streptococcus faecalis* and faecal index are given in intensity chart 1, 2, 3. Faecal index was mostly above 4 indicating the source of faecal pollution from human waste.

Isolation of enterohaemorrhagic *E.coli* (EHCEC) is the causative agent of the potentially life threatening enterohaemorrhagic colitis or haemolytic uraemic syndrome. Plate No.1 shows colonies of *E.coli* isolated in MacConkey agar showing cultural characteristics after 18-24 h at 37° C in TSI-Agar. H_2S is not produced which indicated the absence of *Salmonella* spp. during the study period. Significant level of *E.coli* was detected in all the samples and highest counts were observed in Estuary. Out of 22 surface water sample in estuary and farm sites analysed only 10 *E.coli* (type I) (++— IMVic tests) were isolated.

High rate of incidence of Multiple Antibiotic Resistance (MAR) *Escherchia coli* (type I) in shell-fish farming sites indicated the possibility of R-factor mediated drug resistant

bacteria in this environment with transferable drug resistance. High rate of antibiotic sensitivity was also exhibited by some of the strains. As, there was no hospital record of food-poisoning cases during the study period, all the shellfish farming sites can be considered as clean areas for shellfish farming programmes.



PHYSIOLOGY, NUTRITION & PATHOLOGY DIVISION

The Physiology, Nutrition and Pathology Division undertook research in critical areas of Nutrition, Pathology, Physiology, Genetics and Biotechnology to improve the productivity of coastal aquaculture systems. The Division currently implements 6 in-house projects and 3 externally funded projects.

PROJECT CODE	**PNP/35**
PROJECT TITLE	**Development of feeds and optimisation of feeding regimes for culturable crustaceans, marine finfishes and pearl oysters**
SCIENTISTS	**R. Paul Raj**, D.C.V. Easterson, M. Vijayakumaran, D. Kandasami, Manpal Sridhar, P.Vijayagopal and Preetha Panikkar
CENTRES	Cochin, Tuticorin, Chennai, Calicut

Feed Biotechnology: Experiments on the isolation of putative probionts from the gut of *P. indicus* juveniles and adults were carried out. Two of the isolated strains, a *Bacillus* and a *Micrococcus*, recorded maximum antagonism to three strains of fish pathogens and these were further tested in *P. indicus*. Both the strains failed to elicit any mortality or external or internal pathologies and were thus selected as putative probionts. They were cultured and the harvested biomass was incorporated into compounded feeds by coating in a lipid oraliser as an emulsion containing 5×10^7 cells/g of diet mixed with fish oil and their efficacy determined in a thirty two day feeding experiment in *P. indicus* post-larvae, average weight 0.746 ± 0.038 g.

The proximate composition of the control and probiotics incorporated feeds

Parameter (% dry matter basis)	Feeds Control	PBI *	PMII**
Dry Matter	93.05	93.09	93.18
Moisture	6.95	6.91	6.82
Crude protein	37.84	39.25	43.75
Crude Fat	5.51	5.84	6.16
Crude Ash	12.13	12.31	12.18
Crude Fibre	1.60	2.10	2.02
Acid insoluble ash	1.15	1.20	1.12
NFE ***	35.98	33.61	29.07

* Feed incorporated with biomass of *Bacillus* sp.

** Feed incorporated with biomass of *Micrococcus* sp.

*** Nitrogen Free Extractives-calculated by difference.

Water stability tests of the feeds indicated loss of about 23-25% dry matter at the end of five hours of immersion in water. The results of feeding experiment showed significantly higher level specific growth rates for shrimps in the two treatment groups, 0.846 for *Bacillus* group (PBI) and 0.605 for *Micrococcus* group (PMII) than that of the control group 0.204.

Solid Substrate Fermentation of water hyacinth using freshly cultured *Bacillus coagulans* maintaining 60-70% relative humidity for 48 to 72 hours period resulted in marginal increase (2%) in protein and crude fat contents but a reduction in crude fibre (2%) and NFE upon fermentation.

Proximate composition of water hyacinth (% dry matter basis) before (a) and after fermentation (b) with *B. coagulans*.

Parameter (%)	A	B
Dry matter	95.85	92.36
Crude protein	21.65	24.50
Crude fat	1.64	2.58
Crude ash	19.80	18.85
Crude fibre	16.57	14.34
Acid insoluble ash	1.98	00.64
NFE*	38.09	34.05

*Nitrogen free extractives

- A set of five feeds were formulated by incorporating 20 , 40, 60 , 80 and 100 % of fermented water hyacinth respectively and a control diet devoid of fermented material have been prepared for feeding trials with post larvae and juveniles of *Penaeus monodon*.

Lobster nutrition: An experiment was conducted to study the effect of natural diets enriched with carotenoids in the pigmentation of the spiny lobster *Panulirus homarus*. Microalgae, *Spirulina* and *Hematococcus pluvialis* were used to enrich the marine clam *Donax cuneatus*. Significant increase in total carotenoid concentrations in the exoskeleton and muscle was recorded in the lobsters fed the enriched clams.

After a series of feeding experiments on spiny lobster, *Panulirus homarus* (100-150 g)it was found that about 10% of body weight of feed (mussel meat) was the ideal ration for maximum growth (highest frequency of moulting) in lobsters as compared to feeding with 5% and 15% body weight of feed. Lobsters were found to prefer feed with shell on than shucked meat.

Grouper Nutrition: Optimum feeding rate for maximum growth of juvenile groupers (<500 g) was found to be 10% of body weight, when fresh sardine was used as a feed for over a period of 60 days.

PROJECT CODE **PNP/46**
PROJECT TITLE **Disease investigations in marine fish and shellfish**
SCIENTISTS **M. Vijayakumaran**, A.P. Lipton and S.R. Krupesha Sharma
CENTRES Vizhinjam, Chennai, Calicut

- An experiment was conducted in the spiny lobster, *P. homarus* to confirm whether the mortality recorded in a lobster-holding facility was due to copper toxicity. Copper concentrations ranging from 50 to 5000µg/l. (0.05 to 5 ppm) were tested for toxicity. At 5 ppm, all the lobsters died within 3 hours. Above 0.2 ppm all the lobsters died within 24 hours. At the lowest concentration of 0.05 ppm no mortality was recorded in 96 hours. The 96 hour LC 50 value of copper was estimated as 0.105 ppm. The experiment

confirmed that the mortality in the holding centre was due to copper toxicity as the copper concentration in the holding tanks gradually increased to 2 ppm in 24 hours due to leaching from the cupro-nickel tubes used in the cooling system. The mortality was completely arrested when the cooler was detached from the recirculation system.

- Blackening of the shell in *P. homarus* reared in shallow plastic troughs in laboratory was found to be caused by profuse growth of algae and attachment of thick colonies of the protozoan *Zoothamnium*. Other organisms like diatoms, nematodes and polychaete worms subsequently colonised the area. Seventeen organisms were isolated from the carapace of one lobster. In some cases, shell lesion in the exoskeleton in the abdomen and leg was observed. Dark spots with a halo around it was noticed on the walking legs. However, the lobster could completely regain the original colour after shedding the exoskeleton and there was no trace of shell lesion in the moulted lobsters.
- Eggs and tail of one *P. longiceps* breeder collected from a holding centre were severely infected leading ultimately to its death. Identification of the bacteria isolated (3 from eggs and one from infected tail region) is in progress. Basophilic, intra-nuclear inclusion bodies, with a halo around it were recorded in gill epithelia in one of the spiny lobsters. The inclusion bodies resembled the ones recorded in the white spot disease syndrome in shrimps. There was no external symptom of the disease in the lobster, which was healthy.
- Exophthalmous and skin lesions were observed in the aquarium fish *Holocentrus rubrum* at Mandapam. Potassium permanganate treatment with a pinch of iodine was effective in controlling the disease.
- White Spot Disease syndrome was reported in many shrimp farms in the Calicut region. Vibriosis was also associated with white spot syndrome and this increased the mortality of shrimps. The white spot appeared after 60 days of stocking and the shrimps died two days after the appearance of white spot.

PROJECT CODE	**PNP/ 47**
PROJECT TITLE	**Formulation of Nutritional Strategies for the Management of Aquaculture Wastes (NSMAW) through Low Pollution Diets for Shrimp (Completed).**
SCIENTISTS	**Manpal Sridhar**, M. Peer Mohamed and P. Vijayagopal
CENTRES	Cochin

A number of conventional and non-conventional ingredients were analyzed for their proximate composition, phosphorous and nitrogen contents using standard methods (A.O.A.C 1990). The P/N ratio of most of the ingredients analysed in the present study was below 0.3 except for rice bran, wheat bran, meat meal and water hyacinth which had P/N ratios of 0.65, 0.76, 0.71 and 0.87 respectively. The highest P/N ratio of 7.74 was obtained for tapioca flour. The plant proteins had higher P/N ratios as compared to animal proteins.

Phosphorus, nitrogen and p/n ratios of the conventional and non-conventional ingredients

Ingredient	Crude protein *	Nitrogen	Phosphorous	P/N ratio
Millets	10.30	1.65	0.45	0.27
Rice bran	13.60	2.18	1.41	0.65
Sorghum	12.60	2.02	0.21	0.10
Wheat bran	12.20	1.95	1.49	0.76
Groundnut oil cake	46.91	6.22	0.62	0.10
Coconut oil cake	21.40	3.42	0.42	0.12
Soybean flour	50.96	8.15	0.72	0.09
Tapioca flour	1.72	0.27	2.09	7.74
Gingelly oil cake	31.84	5.09	0.96	0.19
Meat meal	45.60	7.30	5.18	0.71
Blood meal	79.60	12.74	0.30	0.02
Poultry meal	56.20	8.99	0.91	0.10
Fresh trash fish	43.80	7.01	1.96	0.28
Shrimp meal	46.20	7.39	1.21	0.16
Silkworm pupae	51.20	8.19	1.09	0.13
Yeast	48.00	7.68	0.10	0.01
Spirulina	69.10	11.06	1.76	0.16
Clam meal	53.54	8.57	3.65	0.43
Fish meal	61.70	9.87	3.61	0.37
Water hyacinth	12.10	1.94	1.69	0.87

- Based upon these ingredients a few High Nutrient Dense feeds with varying P/N ratios were formulated to test their efficacy in reducing pollution. Feeding trials carried out with juveniles of *P . indicus* (initial weight ranging between 1.27 to 1.79 g) for a duration of 30 days, showed significant differences among the growth performances of the control and treatment shrimp groups. All the HND diets promoted better growth, survival and FCR than the control diet thereby proving their efficacy in reducing pollution.

The growth performance of juvenile *P. indicus* fed the control (C) and hnd feeds (F1 to F6)

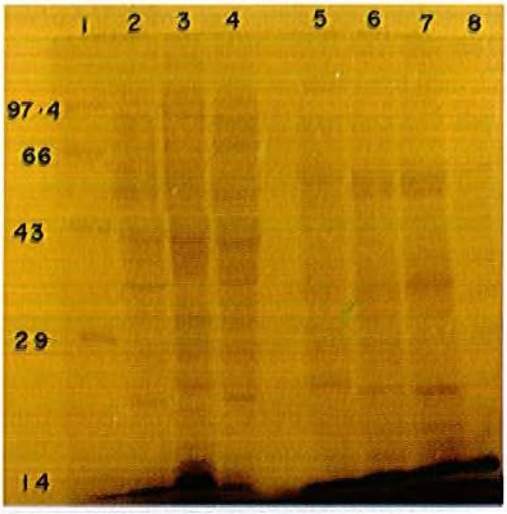
Nutrients	Feed numbers						
	C	F1	F2	F3	F4	F5	F6
Initial length (cm)	6.25	6.82	7.02	5.99	6.23	6.73	5.97
Initial weight (g)	1.99	1.35	0.99	1.27	1.68	1.02	1.83
Final length (cm)	6.43	7.04	7.29	6.32	6.82	6.99	6.54
Final weight (g)	2.17	2.66	1.95	1.78	2.64	1.91	2.67
SGR *	0.19	1.25	1.85	2.54	1.98	0.93	0.83
Survival	78	90	85	80	96	88	95
FCR **	2.86	1.96	1.04	2.03	1.73	1.66	1.90

SGR*- specific growth rate
FCR** - feed conversion ratio

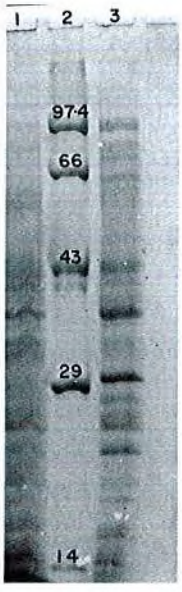
PROJECT CODE	**PNP/48**
PROJECT TITLE	**Development of fingerprints and probes for detection of pathogens of finfish and shellfish**
SCIENTISTS	**P.C.Thomas**
CENTRES	Cochin

Macromolecular and DNA fingerprints of pathogenic bacteria

- Cellular protein profile of four *Vibrio species V. parahaemolyticus, V. fisheri, V. anguillarum* and *V. cholerae* were resolved electrophoretically using lauryl sulphate and beta-mercaptoethanol, and it revealed 38-40 polypeptides. The protein profiles revealed differences among the species with respect to the molecular weight of the peptides. The proteins which showed variations between the species were 34 kDa, 33 kDa, 32 kDa, 20 kDa, 12 kDa and 11 kDa. *V. parahaemolyticus* was distinct by the presence of 20 kDa, 12 kDa and 11 kDa and the absence of 34 kDa, 33 kDa,and 32 kDa proteins in their profile. *V. anguillarum* expressed only 34 kDa and 32 kDa, *V. cholerae* was distinct as only the 33 kDa was expressed. The protein profile resolved in *Aeromonas hydrophila* and A*eromonas salmonicida* also confirmed the existence of significant species specificity. The number of bands resolved for *A.hydrophila* and *A.salmonicida* were 29 and 39 respectively.



Cellular protein profile of the bacterial pathogens
Lane 1.Std.molecular weight marker.
Lane 2. *Vibrio cholerae*
Lane 3.*V. nguillarum* Lane 4.*V.fisheri*
Lane 5. *V. parahaemolyticus* Lane 6. *Salmonella typhi*
Lane 7. *Pseudomanas* sp. Lane 8. *Escherichia coli*



Cellular protein profile of *Aeromonas hydrophila* and *A. salmonicida*
Lane 1 *Aeromonas hydrophila*
Lane 2. Std.molecular weight marker
Lane 3. *A. salmonicida*

- DNA fingerprint pattern of *Vibrio* species was analysed using random primed PCR amplification of the template DNA isolated from them. Trials using Operon 10-mer primer OPAH-5 revealed 6-7 amplified fragments ranging from 0.4 to 2 Kb size. While five of the seven amplified segments were typical to all the members of the *Vibrionacea* family, differences were noticed with respect to 0.5 kb and 1.5 kb segments, which were not amplified in *V. parahaemolyticus* and the two *Aeromonas* species.

Molecular detection of White spot baculovirus

- A simplified protocol for the isolation of White Spot Baculovirus (WSBV) DNA

template from the infected shrimp tissue was perfected. Molecular detection of the WSBV, through the amplification of single copy DNA segments flanked by specific pair of primers also have been standardized in the laboratory. Trials were carried out to amplify WSBV DNA template isolated from *P. indicus* and *P. monodon* with a pair of primers used for the WSBV of black tiger shrimp in Taiwan. A series of experiments have been carried out by which the concentration of template DNA, primer concentration, enzyme concentration as well as that of d NTPs for the PCR amplification have been optimized. A PCR product of 1447 kb was amplified indicating homology between the virions of Indian white spot and that of the Taiwanese.

A pair of primers were designed based on the published sequence information of RV-PJ virus reported to be causing the white spot disease of *P. japonicus* in Japan. Amplification of WSB viral DNA isolated from *P. indicus* affected with white spot disease with these primers indicate homology between WSBV and RV-PJV.

PROJECT CODE	**PNP/49**
PROJECT TITLE	**Population genetic studies in *Rastrelliger kanagurta* and *Sardinella longiceps***
SCIENTISTS	**P. Jayasankar** and P.C. Thomas
CENTRES	Cochin

- Truss network analysis and RFLP of mtDNA have revealed interspecific polymorphisms in mackerel and oil sardine. PAGE of muscle tissue proteins revealed 4 genetic loci in mackerel and characterization of homozygotes and heterozygotes has been done. In a study using RAPD (Random Amplified Polymorphic DNA) markers, oil sardine from Kochi revealed 8-10 bands in the size range of 1-2 Kbp, with a prominent marker of 1.9 Kbp. They were amplified by arbitrary primer OPA15. The 1.9 Kbp band could prove to be a species-specific marker. The RAPD technique has been standardized for both the species and it is envisaged to employ a battery of informative arbitrary primers for amplifying DNA and detecting polymorphisms for establishing stock differences, if any.

PROJECT CODE	**PNP/52**
PROJECT TITLE	Studies on the effect of toxins, pollutants and probiotics in fish health with special reference to immune system.
SCIENTISTS	**K.C.George,** N.K.Sanil and K.S.Sobhana
CENTRES	Cochin,

- A series of experiments were conducted to evaluate the effect of the organophosphorus pesticide, dichlorvos (Nuvan) on non-specific immunity of the pearl spot, *Etroplus suratensis*. Acute inflammation was induced using Freund's Complete Adjuvant (FCA) in Nuvan exposed (sub-lethal doses, 0.02 and 0.05 ppm) and control fishes. Initial neutrophil responses were almost similar in both treatment and control groups. However, the peak response occurred in control animals at 48 hours and in treatment groups it appeared after 72 hrs. The granulomatous reaction was evident on the 3rd day in control fish and continued even after 15 days. Severe macrophage accumulation and appearance of

epitheleoid cells were evident in control animals. These reactions appeared much subdued in treatment groups. Fibroblast proliferation, which was a healing process, was also suppressed in the treatment group. Ultra-structural studies revealed the margination and migration of leukocytes through endothelial junctions.

- Experiments were also conducted to study the effect of Nuvan, at a sub-lethal dose of 0.05 ppm, on *in vitro* phagocytic activity in *Etroplus suratensis*. The phagocytic index and percentage of phagocytosis were reduced in treatment group (1.1 and 65 % respectively) compared to the control group (2.5 and 80 % respectively). Thus the observations established that the organophosphorous pesticide, nuvan can suppress the non-specific immune mechanisms like inflammation and phagocytosis in *E. suratensis*.

PROJECT CODE **PNP / 53**

PROJECT TITLE **Extraction and isolation of substances of pharmacological importance from marine organisms**

SCIENTISTS **R. Paul Raj**, P.A. Thomas, A.P. Lipton, I. Rajendran and T. Narender

CENTRES Cochin, Vizhinjam, Mandapam

- Three species of seahorses namely *Hippocampus kuda, H. histrix, H. zosterae* were collected from Colachal and Chinnamuttom in Kanyakumari district and shade-dried. Aqueous extract was prepared from these dried seahorses and condensed. The extract, when added to a growth medium enhanced the growth of the selected microbial isolates. However, no antibiotic activity was recorded.
- Methanolic extract prepared from a sponge when eluted with hexane and ethyl acetate in column chromatography yielded two compounds which were recrystallized and attempts are being made to obtain the spectral data.
- Starfish collected from Neendakara Fisheries Harbour, Kollam, was also dried and the dried material was extracted with hexane and two compounds were obtained. The spectral data of the compounds as well as their antimicrobial activity are being studied.

SOCIO-ECONOMIC EVALUATION AND TECHNOLOGY TRANSFER DIVISION

The division has undertaken nine research projects - 6 Institutional, 2 NATP and one funded project by MoE & F for the year 2000-2001. The division implemented transfer of technology programmes through organising Farmers-Industry-Institution-Scientists meets in different locations and participating in exhibitions. Besides providing audiovisual supporting services, the Division has taken care of the innumerable visitors by explaining various activities of the Institute.

PROJECT CODE FE&E/31
PROJECT TITLE **Empowerment of coastal communities through fisheries extension**
SCIENTISTS **Sheela Immanuel**, R. Narayanakumar, S. Ashaletha, C. Ramachandran and V.P. Vipinkumar
CENTRES Cochin and Calicut

Crab farming and integrated fish culture were identified as potential technologies to be adopted by the coastal fisherfolks in the second phase of the empowerment programmes in Ernakulam district. In Panambukad 13 farmers having a pond size of about 20 cents each were provided with 40 kg of crab seed collected from the wild. The project staff provided regular monitoring and technical guidance. Training was given to the farmers in crab farming.

In Elankunnapuzha, prawn culture was demonstrated in 12 farmers' ponds of 20-30 cents. Twenty farmers were given training in crab farming and another fifteen in prawn farming. Three Fishermen-Farmers-Industry-Institutions meets were organised on selected themes to transfer the technologies developed by the Institute.

PROJECT CODE FE&E/32
PROJECT TITLE **Integration of small scale mariculture with small scale fisheries along the peninsular India**
SCIENTISTS **A Regunathan** and P.S. Swathilekshmi
CENTRES Chennai

A socio-economic survey was conducted at Nettukuppam village near Ennore Estuary to study the problems faced by fishermen and the possible displacement of fishing in the estuary. 77 fishermen were selected for the study. Pollution, spread of skin disease and lack of employment were the major problems reported by the fishermen. The study revealed that most of the fishermen were in middle aged group and about 35% of them had education upto primary level. Though fishing is considered as their main occupation (57% of the population) a substantial percent of the population (38%) was engaged in non-fishing occupations.

PROJECT CODE	**FE&E/33**
PROJECT TITLE	**Economics of resource management and socio-economics of small scale fisheries**
SCIENTISTS	**R. Narayanakumar** and R. Sathiadhas
CENTRES	Cochin

The costs and earnings data collection from different fishing units at Veraval, New Ferry Wharf, Mangalore, Malpe, Sakthikulangara, Madras, Kakinada, Bhairava Palam and Visakhapatnam were continued. The analysis of data showed that the operating cost per trip varied from Rs 4016 in Mandapam to Rs 7350 in Sakthikulangara for a single day trawl trip. Among the different components of the operating costs, fuel accounted for 48-53% and wages to labour 25-27%. The net operating income per trip ranged from Rs 1,633 at Mandapam to Rs 2,960 at Sakthikulangara. For multiday trawling of 3 day trip, the operating cost was Rs 17,431 at Cochin Fisheries Harbour and Rs 18,042 at Sakthikulangara. The gross revenue earned per trip was Rs 26,980 in Sakthikulangara and Rs 30,356 at Cochin Fisheries Harbour. The net operating income per trip was Rs 8,938 at Sakthikulangara and Rs 12,925 at Cochin Fisheries Harbour.

The analysis of the economic performance of the gill netters showed that the operating cost per trip varied from Rs 683 for a motorised boat at Tuticorin to Rs 3161 for a mechanised boat at Chennai. The gross earnings per trip worked out to Rs 1273 for the motorised boat and Rs 4375 for the mechanised boat thus earning a net operating income per trip of Rs 587 and Rs 762 respectively.

PROJECT CODE	**FE&E/36**
PROJECT TITLE	**Economic evaluation of marine fish marketing system and price structure**
SCIENTISTS	**R. Sathiadhas** and R. Narayanakumar
CENTRES	Cochin

The data on prices of all commercially important fish varieties traded at the landing centres, wholesale and retail markets in and around Veraval, Karwar, Mumbai, Mangalore, Vizhinjam, Tuticorin, Mandapam, Chennai, Kakinada and Visakhapatnam were collected. At the national level, the average landing centre price varied from Rs 6/kg for oil sardines to Rs 78/kg for pomfrets. The average landing centre price for prawns varied from Rs 80/- per kg for small sized prawns mostly channelled to domestic market supply to Rs 450/kg for big sized prawns export market.

The average wholesale market price ranged from Rs 9/kg for silverbellies to Rs 85/kg for pomfrets. The retail market price on an average varied from Rs 15/kg for Bombay duck and silverbellies to Rs 108/kg for pomfrets. At the state level the average landing centre price varied from Rs 3 per kg for anchovies and oil sardine in Tamilnadu to Rs 109/kg for pomfrets at Mumbai. The average price per kg for fish varieties in wholesale market varied from Rs 4 for silverbellies at Visakhapatnam to Rs 185 for pomfrets at Veraval. In the retail fish market, the average price per kg ranged from Rs 5/- for silverbellies in Visakhapatnam to Rs 245 for pomfrets at Veraval. The results indicated that the Gross Marketing Margin (GMM) or price spread varied from Rs 6/kg for mackerel and Bombay duck to Rs 30/kg for pomfrets. The percentage

share of fishermen in consumer Rupee (PSFCR) ranged from Rs 23.28 for oil sardine to 88 for pigface breams. Similarly, the price spread in fishermen's share in the consumer rupee for all commercially important varieties in all maritime states have been worked out.

PROJECT CODE	**FE&E/37**
PROJECT TITLE	**Women in fisheries - an analysis of the gender disparities and strategies for development**
SCIENTISTS	**Ashaletha, S**, Sheela Immanuel, C. Ramachandran, V.P. Vipinkumar and P.S. Swathilekshmi
CENTRES	Cochin, Calicut and Chennai

The project is perceived to be conducted in Kerala and Tamilnadu. An extensive Participatory Rural Appraisal (PRA) was conducted in selected fishing villages of Alapuzha, Ernakulam and Thiruvananthapuram districts of Kerala. A questionnaire was developed to collect data for the project, based on the interactive discussions held and results of the PRA. Women engaged in ten different avocations, namely, prawn peeling, marketing, processing, value addition, fish drying, culture, clam fisheries, seaweed collection, pearl culture and beach works were identified in Kerala and Tamilnadu for the survey based on the proportion of fisherwomen involved in each category of activities. The interview schedules were developed separately for each sample category identified in the study area. The sample respondents were selected using proportionate sampling method. The data collection has been initiated in the study area by engaging trained enumerators.

PROJECT CODE	**FE&E/38**
PROJECT TITLE	**Behavioural pattern of fisherfolk on changes in technology regime and regulatory mechanisms**
SCIENTISTS	**C. Ramachandran**, Sheela Immanuel, S. Ashaletha, V.P. Vipinkumar and P.S. Swathilekshmi.
CENTRES	Cochin, Calicut and Chennai

The data collection tools like interview schedule and PRA protocol have been developed and got pretested in Kerala and Tamilnadu. The PRA exercises conducted in Chellanam and Munambam indicated qualitative variation in the major variables taken for the study viz., perception of new technology, adoption behaviour, response towards regulatory mechanisms and conservation orientation across the three categories of respondents viz., artisanal, motorized and mechanised fisherfolk. The data collection through interviews (both structured and free wheeling) have been initiated in selected coastal villages of Kerala (18) and Tamilnadu (12), covering a total sample of 1200 in both the states.

SPONSORED PROJECTS

The Institute has research and development projects funded by various agencies like Department of Ocean Development, Department of Biotechnology, Ministry of Environment and Forests, International Foundation for Science, Sweden and ICAR under the Cess fund scheme. A brief report of the findings under these projects is presented below.

FUNDING AGENCY	**ICLARM-Penang**
PROJECT TITLE	**Sustainable Management of Coastal Fish Stocks in Asia**
SCIENTISTS	**K. Gopakumar (DDG -Fy,ICAR)** V. N. Pillai, M. Srinath, K.N. Kurup, E. Vivekanandan and Sheela Immanuel
CENTRES	New Delhi, Cochin, Chennai

During 2000, analysis of the data pertaining to the exploratory trawl survey along the southwest coast of India by the Integrated Fisheries Project was completed. The important features are:

1. The biomass of demersal fish stocks along the SW coast was estimated as 1,47,705 t.
2. Scads (22.8%), threadfin breams (19.8%), major perches (10.1%), bull's eye (8.6%), sciaenids (6.1%) and rays (5.8%) constituted the bulk of the biomass.
3. The annual average catches of large and medium predators, demersal feeders and detrivores have exceeded the estimated biomass and hence, scope for increasing their catches is limited. There is scope for increasing the catches of large zoobenthic feeders, mesopelagic feeders and plankton feeders.
4. Gears employed for exploitation of demersal resources, particularly the bottom trawl, are being excessively used. Gears employed for exploitation of pelagic resources are underutilized.

National Consultative Planning workshop of the ICLARM - ICAR collaborative project ADB-RETA 5766 "Sustainable Management of Coastal Fish Stocks in Asia"

FUNDING AGENCY	**Department of Ocean Development, Government of India**
PROJECT TITLE	**Studies on the Deep Scattering Layer (DSL)**
SCIENTISTS	**N.G.Menon**
CENTRE	Cochin

Eight cruises of FORV *Sagar Sampada* were undertaken in the Indian EEZ.

West Coast

Along the West Coast of India DSL

collections were made from 77 stations (42 day and 35 night). The area covered was between 6 ^{0}- 21^0 N and 65 ^{0}-77 ^{0}E. The DSL appeared in single and multiple layers and the thickness of the layers varied from 10 to 260 m. The biomass values were in the range 0.17 g /1000 m^3 to 30.53 g /1000 m^3 with the lowest at 11^{0}20'N and 74^{0}50'E and highest at 12^{0}29'N and 74^{0}04' E. Major components were the pelagic shrimps and myctophids. The other components were fishes belonging to families Gonostomatidae Photichthyidae, Sternoptychidae, Astronesthyidae, Chauliodontidae, Nemichthyidae, Bregmacerotidae, Trichuridae.

In the day hauls, the total biomass of 9.73 g / 1000 m^3 was formed by nekton (75%) and the zooplankters (25%). During night hauls, 51% of the total biomass (32.32 gm / 1000 m^3) was contributed by nekton and 49% was constituted by zooplankters. The major zooplankters present were medusae (39%), ctenophores (18.5%), jelly like substances (18%) and euphausiids (11%).

Multilayers of DSL were collected at 6^0 40'N and 77^{0}30'E from depths 30 - 40m and 390 - 400m. A 60m thick layer below 350m at night (21.00hrs) was observed. The appearance of diffuse / thick, more or less scattered layers below 350m during night time was noticed throughout the 6^0 latitude. This 50m thick layer had a biomass of 15.59 g /1000 m^3 (110 no/1000 m^3) and about 76% of the biomass (ml /1000 m^3) were formed by the nekton. Pelagic shrimps, chauliodontidae, crabs, myctophids and cephalopods contributed significantly. The 120m thick layer observed in the surface waters had a biomass of 12.35 g /1000 m^3 (203.18 no /1000 m^3). About 45% of the catch were formed by the zooplankters and the remaining 55% were contributed by the nekton. Myctophids, leptocephalus and pelagic shrimps were the major nektonic components and the dominant zooplankters were euphausiids and siphonophores. Most of the cephalopods encountered in the deep layer were larger when compared to the ones obtained from the surface layer.

Sergestes inous **of the DSL along the west coast**

East Coast

Four cruises were operated along the East Coast of India. There were a total of 63 (35 day and 28 night) IKMT stations during the period. The areas under study were between 10^0-20^{0}N and 80^0-95^{0}E. The depth of the stations varied from 300 to 3500m and the sampling depth was between 40 and 480m.

The biomass values varied from 1.66 ml /1000 m^3 to 7.59 ml /1000 m^3 with the highest values at 13^0 22'N and 80^0 32'E and the dominant items were the pelagic shrimps (90.10%). The nekton of the DSL in the east coast was less diverse when compared to that in the west coast and fish families that mainly appeared were Myctophidae, Photichthyidae, Sternopthychidae, Bregmacerotidae and Stomiidae.

FUNDING AGENCY	**Department of Ocean Development, Government of India**
PROJECT TITLE	**Resources assessment and biology of deep-sea fishes along the continental slope of Indian EEZ**
SCIENTISTS	**V. Sriramachandra Murty**
CENTRE	Cochin

Participated in three cruises of the *FORV Sagar sampada* along the West Coast of India and the Andaman Sea. Along the west coast a catch of 1341 kg was recorded with a CPUE of 67kg/hr in the depth range of 65 – 710 m. Deep sea prawns *Heterocarpus gibbosus and H. woodmasoni* constituted 25.5% of the catch at a depth of 300-400m (off Allepey). In this grid a CPUE of 132 kg/hr was recorded for prawns. The catch also consisted of deep sea fishes like *Chlorophthalmus agassiz, Cubiceps caeruleus, C. baxteri, Macrorhamphosodus uradoi, Priacanthus hamrur* and *Sphyraena obtusata* and shrimps like *solenocera hextii, Aristeus alcocki* and *plesionika ensis.*

In the Andaman Sea, a catch of 3325 kg was obtained with CPUE of 214.5 kg/hour in the depth range of 200-528m. The major components of the catch were *Cubiceps pauciradiatus* and *Cubiceps caeruleus*, which constituted about 45.25% of the total catch. The area south of Sentinel Islands recorded highest catch (2920 kg) during the cruise with CPUE of 495 kg/hr at a depth of 300 m. The important fishes recorded during the cruise were *Bembrops platyrhynchus, Priacanthus hamrur, Psenopsis cyanea, Psenopsis obscura, Chlorophthalmus punctatus, Saurida undosquamis, Neoscopelus microchir, Polymixia nobilis* and shrimps like *Plesionika ensis, Heterocarpus gibbosus* and *Heterocarpus woodmasoni.*

In another cruise along the west coast of India, a catch of 9706 kg with a CPUE of 466 kg/hr was obtained from the depth range of 220 to 750 m. Of this, about 6100 kg was taken in depths of 295 – 308 m (Off Quilon). The catch mainly composed of *Chlorophthalmus punctatus* (4950 kg) while other fishes like *Chlorophthalmus bicornis, Psenopsis cyaenea, Cubiceps pauciradiatus* and *Neoepinnula orientalis* also occurred in the catches.

FUNDING AGENCY	**ICAR - AP CESS**
PROJECT TITLE	**Onshore culture of marine pearls**
SCIENTISTS	**P.V. Sreenivasan**
CENTRE	Chennai

Growth: Pearl oysters were reared at a stocking density of 1 oyster / 3 l of seawater and fed with mixed algal diet at 1 lakh cells/ml. The growth rate was slow but continuous and attained an average DVM size of 43.2 mm (size range 34.2 - 47 mm DVM) in one year from an initial size 16.9 mm (DVM) (size range 13.0 - 24.0 mm DVM). Higher growth in length and wet weight was at a feed dose of 2 lakhs cell/ml divided over two time feeding per day.

Efffect of Starvation: The effects of starvation on the mortality of pearl oyster (*Pinctada fucata*) was studied for a period of 85 days. The mortality of pearl oysters increased from day 60. Cumulative mortalities reached 95% on day 80. The glycogen content of the adductor muscle decreased rapidly during the first week. Dry meat weight losses increased more than 70%, wet meat moisture content increased from 81-91. When the condition index dropped below 4 and dry meat loss increased more than 70%, the mortality of unfed pearl oysters remarkably increased.

Oxygen Consumption : Experiments on oxygen uptake of *P. fucata* was studied in different salinities of 40, 35, 30, 25 & 20 ppt in relation to sizes (20-29 mm, 30-39 mm, 40-49 mm & 50-60 mm in DVM) showed that the oxygen consumption was maximum in the lowest salinity of 20 ppt. among all the size groups. This was due to the increase in metabolism when subjected to stress because of low salinity. The oysters showed minimum consumption of oxygen in the normal salinity of 35 ppt. Oxygen consumption of the pearl oyster in different size groups was higher in small animals than that of larger one.The effect of starvation on the O_2 consumption of *Pinctada fucata* indicated that the oxygen consumption decreased with starvation in all the size groups.

Transportation and its effect on implanted oysters: 30 implanted oysters (15 days after implantation) were transported from Mandapam Regional Centre of CMFRI to Kovalam Field Laboratory of CMFRI for the production of pearls in onshore tanks. 50% oysters died within 2 days. Rest of the oysters have been maintained in onshore tanks with a feed dose of 80,000 cells/ml of water twice a day.

Artificial feed : Artificial feed containing spray-dried cells of *Schizochytrium sp.* [with a fatty acid profile of over 24% docosahexaenoic acid (DHA)] was given to pearl oysters . Consumption of this feed was good with no mortality of oysters and it maintained excellent water quality.

Genetic application : Stripe spawning method was found much better for attaining eggs for triploidy induction. Pearl oysters were stripped for gametes and later given chemical treatment with 6 Dimethyl Amino Purine to induce triploidy. Eggs were subjected to 3 concentrations of 6 DMAP, 25, 50 and 100 microgram, when 50% of the eggs had extruded the first polar body. The exposure time to 6 DMAP on triploid induction was tested at two different timings. (i.e. 5 and 10 mins) post fertiliziation. Triploidy percentage in day 0 larvae, were determined by chromosomal counts.

FUNDING AGENCY ICAR REVOLVING FUND

PROJECT TITLE **Commercial propagation of marine pearls adopting onshore culture technology**

SCIENTISTS **A.C.C. Victor,** A. Chellam, D. Kandasamy and I. Jagadis

CENTRE Mandapam Camp

Pearl Farm Stock A total stock of 4,03,995 pearl oysters of different sizes 2,49,360 spats (5-20 mm), 86,850 medium sized oysters (20-30 mm) and 34,316 mother oysters (above 35 mm) were reared in the farm. Apart from this, about 33,469 nucleated oysters were maintained in the farm.

Spat production: Regular spawning programme continued during the period and yielded an initial settlement of about 9.5 lakhs spat (less 1.0 mm) .

Nucleus implantation: During the period a total of 40,857 oysters were nucleated with 3,4 & 5 mm shell bead nucleus and transplanted to open sea farm for further rearing and pearl production.

Harvest and pearl production: When 21,278 oysters which survived out of the 44,965 nucleated oysters (47.3%) at the end of culture period of 8-9 months were harvested, 9,320 oysters were found to have retained the implanted nucleus (43.8% of surviving oysters) from which 2,177 commercial grade pearls (10.2% of pearls) were produced consisting A-136 nos., B-276 nos and C-1,765 nos.

Pearl sale :During the period pearls worth Rs.1,00,927 were sold. The cumulative pearl sale yielded Rs.2,86,460 under the project.

FUNDING AGENCY	**ICAR - AP CESS**
PROJECT TITLE	**Application of trophic modelling and multispecies virtual population analysis to formulate management options for the multigear marine fisheries of southern Karnataka**
SCIENTISTS	**K.S. Mohamed,** P.U. Zacharia, C. Muthiah, P.K. Krishnakumar, Prathibha Rohit
CENTRES	Mangalore

- 31 fish species were sampled for collection of L/F data and stomach content data
- A total of 6320 L/F data and 3924 stomach data were collected
- L/F data are being entered in FISAT for estimation of growth, mortality and biomass
- Stomach data were analysed using gravimetric and index of preponderance methods for 6 groups of fishes.
- The preliminary data thus obtained was used to arrive at a tentative diet matrix
- All resources were grouped into 10 ecological groups for trial running of ECOPATH. The ecological groups were apex predators, epipelagics, mesopelagics, benthic carnivores, small pelagics, benthic omnivores, heterotrophic benthos, zooplankton, phytoplankton and detritus. Trial run of ECOPATH was done. The number of successful runs was low and more tuning of the data seems necessary.

FUNDING AGENCY	**ICAR - AP CESS**
PROJECT TITLE	**Development of seafarming technology for *Babylonia* Sp**
SCIENTISTS	**K.K. Appukuttan,** P. Laxmilatha
CENTRE	Cochin

Monitoring of whelk (*Babylonia*) fishery at Neendakara and Sakthikulangara Fishing Harbours and studies on their biology were initiated. Broodstock of *Babylonia* were collected from the Fishing Harbour and transported to the hatchery at Headquarters. These were conditioned for spawning.

FUNDING AGENCY	**ICAR - AP CESS**
PROJECT TITLE	**Large scale culture of *Gracilaria edulis* by reproductive method**
SCIENTISTS	**Reetha Jayshanker**
CENTRE	Cochin

For the first time *Gracilaria edulis* was grown in the off shore area of Arabian Sea off Kochi where the natural vegetation of this species does not exist. The spores liberated in the natural environment and the laboratory-reared germlings transplanted to the sea grew to harvestable size. The work was carried out with the involvement of local fisher folk .The results suggest that *G.edulis*, a species of East Coast can be cultured in West Coast provided they were farmed during the favourable period for growth. Based on the result, pilot farming was launched by installing two floating rafts of 5x5 m^2 size . 298 nylon ropes of 1.5 m length were hung in a randomized block design in the raft. Reproductive plants were tied intermittently in plastic perforated bags for natural collection of spores on the inserted fishing net of the nylon rope. Further 83 nylon ropes of same size with laboratory reared germling were hung in a 10 mm long line rope which was tied between two rafts.

FUNDING AGENCY	**ICAR - AP CESS**
PROJECT TITLE	**Conservation of Green turtle *Chelonia mydas***
SCIENTISTS	**M. Rajagopalan**
CENTRE	Chennai

Surveys carried out around Vizhinjam and Tuticorin indicated that meat was sold at these centers despite Wildlife Protection Act. Turtle meat was sold at the rate of Rs.50 to 60 per kg. Nesting of Olive ridley *Lepidochelys olivacea* was noticed in these areas and there was no evidence of nesting of green turtle *Chelonia mydas*.

The concentration of heavy metals such as copper, zinc, cadmium, lead and mercury in the tissues of *Lepidochelys olivacea* and *Chelonia mydas* collected from fish markets of Kerala and Tamil Nadu were analysed. Among the metals analysed, higher concentration levels were noticed in the tissues of *C.mydas* when compared to *L.olivacea*.

FUNDING AGENCY	**DEPARTMENT OF OCEAN DEVELOPMENT**
PROJECT TITLE	**Investigations on the toxic algal blooms in the EEZ of India**
SCIENTISTS	**C.P. Gopinathan**
CENTRES	Cochin

Out of the 12 cruises on board *FORV Sagar Sampada*, 5 cruises recorded the algal blooms, the analysis of samples revealed dominant concentrations of toxic phytoplankton species than non-toxic species without any seasonal variations. A total of 16 genera and 67 species has been identified. Species of *Ceratium, Ceratocorys, Notiluca, Gymnodinium* and *Trichodesmium* were the dominant groups. The environmental parameters in the bloom areas showed a decrease in nutrient concentrations and an increase in pH and primary production.

FUNDING AGENCY	**DEPARTMENT OF BIOTECHNOLOGY**
PROJECT TITLE	**Genetic manipulation of seaweeds by cell structure and somatic hybridisation**
SCIENTISTS	**C.P.Gopinathan** and P.K.Kaladharan
CENTRE	Cochin

Callus induction and shoot initiation were attempted in the explants of *G. edulis* PES medium supplemented with 5ppm 2,4-D and 2-3 ppm Kinetin induced a thin film of callus at the cut ends of explants kept in dark. Multiple " Shoots" developed after 34 days.

Agarolytic activity was estimated from *Oscillatoria* sp, a bluegreen algae growing as epiphyte in the laboratory cultures of *G.edulis*. Crude agarase could be extracted from this alga for commercial purposes. Seaweed protoplast of *G.edulis* and *G.corticata* were isolated with the help of seaweed protoplast washing medium (SPW) containing 0.5% Pectinase, 3% Cellulase, 3% Macerozyme, 2% Agarase. Osmoticum was maintained isotonic by adding 8-10 % Mannitol at pH 6. Isolated protoplasts were suspended in SPW medium without enzyme and attempted fusion in the electric field 1.5 v AC for 2 seconds with a pulse length, charge volt and number of pulses of 0.03m sec, 0.03m sec, 0.08v DC and 8 respectively, and 25% PEG and 5 m M $CaCl_2$, which resulted in protoplast fusion and karyogamy in *G.edulis*.

FUNDING AGENCY	**INTERNATIONAL FOUNDATION FOR SCIENCE, SWEDEN**
PROJECT TITLE	**Effect of probiotic feeding in the rearing and production of marine shrimp larvae**
SCIENTISTS	**K.S. Mohamed**
CENTRE	Cochin

Experiment 1, which includes screening, isolation and identification of probiotic micro-organisms from shrimp culture medium/shrimp guts was initiated first. Penaeid shrimp guts were sampled aseptically and serial dilutions were used to inoculate agar plates (LMRS for isolation of anaerobic Lactobacillii, SWA for isolation of hterotrophs and TCBS for isolation of vibrios) using the spread plate method. More than 12 promising colonies, which developed in the plates, were further characterised using API 20A, 20E and 20C strips for use as probionts. Pure cultures of the isolated colonoies are being maintained by subculturing on agar plates and slants.

Besides, three strains *viz.*, *Lactobacillus acidophilus*, *L. plantarum* and *Pseudomonas echinoides* were procured from MTCC. Chandigarh, India. The probiotic yeast *Saccharomyces boulardii* was obtained from Unite mixte de Nutrition des Poissons, IFREMER Centre de Brest, France as a gift. These strains are being maintained in the laboratory and will also be used for tests.

Experiment 3 on enrichment of *Artemia* nauplii was carried out with the yeast *Saccharomyces boulardii*. At the enrichment level of 10^4 yeasts. ml^{-1}, the count obtained with 24-h enrichment was 35 x 10^2 cfu.$nauplii^{-1}$. The study showed that SB could be enriched into the gut of Artemia nauplii, which can be later used to feed the larvae of shrimp. The challenge test showed that enrichment helped the nauplii to overcome an artificial *Vibrio* infection ($p<0.01$ at 48h, 33% survival in control *versus* 91% survival in T3 treatment).

FUNDING AGENCY	**INTERNATIONAL FOUNDATION FOR SCIENCE, SWEDEN**
PROJECT TITLE	**Environmental Impact Assessment of suspended culture of the green mussel *Perna viridis* and the edible oyster *Crassostrea madrasensis* in a topical estuarine ecosystem**
SCIENTISTS	**V. Kripa**
CENTRE	Cochin

To study the impact of suspended oyster culture on the sediment characteristics and benthic fauna, the commercial oyster farms and the Institutes demonstration farm at Dalavapuram were selected. Variation in the sediment composition (grain size) and water current between the farm and reference sites were observed.

FUNDING AGENCY	**MINISTRY OF ENVIRONMENT AND FORESTS**
PROJECT TITLE	**Environmental economic analysis of inshore fisheries resources of coastal Kerala**
SCIENTISTS	**R. Sathiadhas** and R. Narayanakumar
CENTRE	Cochin

The southern part of Kerala from Trivandrum to Ernakulam has been selected for this study. The selected zone has been classified into three coastal locations namely, (a) highly

degraded. (b) degraded and (c) comparatively undisturbed depending upon the intensity of environmental threats like pollution, degradation of mangroves, dumping of wastes in the sea and coconut husk retting. For the purpose of assessment of environmental impact on inshore fishery resources different craft-gear combinations have been identified. The catch compositions by the different craft-gear combinations in these areas over the years will be analysed.

FUNDING AGENCY	**ICAR - AP CESS**
PROJECT TITLE	**Studies on the defense mechanism and host-pathogen interactions in bacterial and viral diseases of crustaceans and bivalves**
SCIENTISTS	**K.C. George**, N.K. Sanil, K.S. Sobhana and P.C. Thomas
CENTRE	Cochin

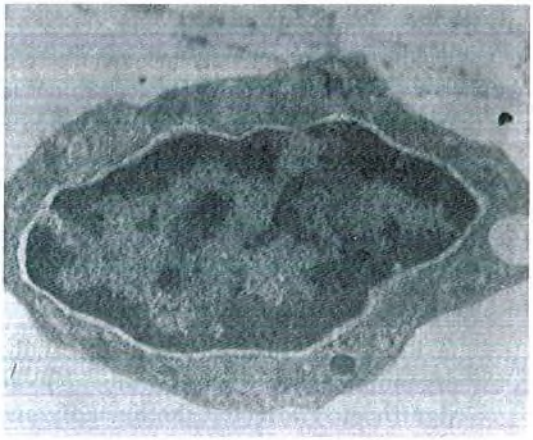
- The hemocytes in *Penaeus indicus* were characterized by light microscopy and transmission electron microscopy. Three types of haemocytes were identified by light microscopy. They were hyalinocytes, with a large nucleus and scanty cytoplasm without any granules. The second type of cells classified as intermediate granulocytes were having basophilic granules of small size. The 3rd type, classified as granulocytes had large eosinophilic granules. TEM observations showed hyalinocytes with cytoplasm, a few vacuoles and occasional granules. Intermediate granulocytes appeared oval or ellipsoid in shape and had irregular shaped nuclei and vacuoles and small electron dense granules were present. Granulocytes have rough endoplasmic reticulum and a large number of electron dense granules of varying sizes.

- The effect of stress factors like salinity and the organophosphorous pesticide Nuvan on the haemolymph of *P. indicus* was studied. The total hemocyte count, differential hemocyte count and total protein in *P. indicus* exposed to different salinities (3ppt, 10 ppt and 25 ppt) and organophosphorous pesticide, Nuvan (0.01 ppm, 0.05 and 0.10 ppm) were recorded. Salinity did not significantly affect the protein and total hemocyte count. However in differential count, the hyalinocytes and intermediate granular cells showed a decrease (from 39% at 25 ppt to 28% at 3 ppt and from 62% at 25 ppt to 58% at 3 ppt respectively). Granulocytes showed an increase from 11% at 25 ppt to 17% at 3ppt. In Nuvan exposed animals, the differential count of hyalinocytes decreased with an increase in concentration (from 59.3% in control to 47% at 0.1 ppm Nuvan).

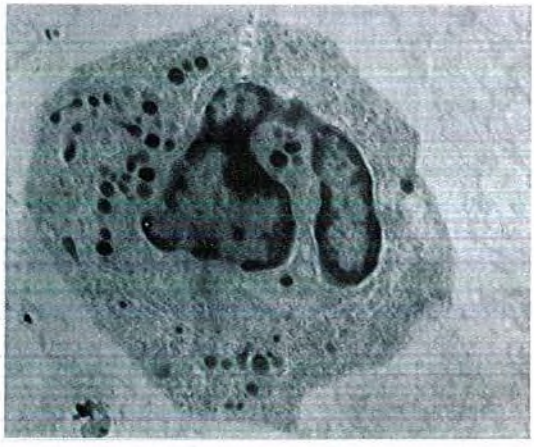
- In the oyster, *Crassostrea madrasensis*, the organophosphorus pesticide Nuvan significantly affected the haemolymph characteristics on exposure to 0.2 ppm concentration. The nuvan treated animals had lower total hemocyte count (67.58×10^4 cells/ml of hemolymph) than the control (194.42×10^4 cells/ml of hemolymph). Exposure to nuvan also resulted in reduction in the percentage of granulocytes (34.31% in control and 22.38% in 0.2 ppm nuvan treated group) and semigranulocytes (49.25% for the control and 23.79% for the treatment) but the percentage of hyalinocytes increased (16.43% for the control and 53.83% for the treatment). The phagocytic index (39 for control and 21 for treatment), endocytic index (0.65 for control and 0.37 for treatment) and total protein content (420.5 mg/ml for the treatment and 638.56 mg/ml of hemolymph for control) showed a decrease on exposure to nuvan. There was no significant change in the hemolymph protein profile as normal

bands of 26 kDa, 31 kDa, 74 kDa and 86 kDa were recorded in both the control and the treatment groups.

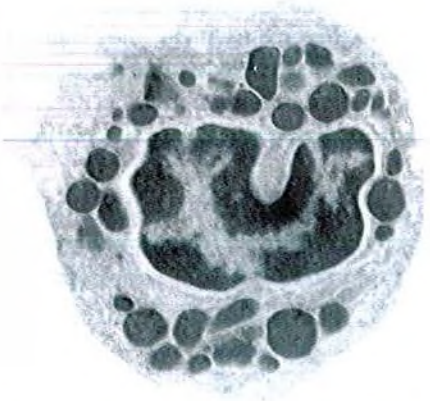
- In the oysters exposed to copper (1 ppm) the total hemocyte count showed a significant decrease as compared to the control (228 x 10^4 cells/ml of hemolymph in control and 70.8 x 10^4 cells/ml in treatment). There was a reduction in the percentage of granulocytes (83% in control and 60.46% in treatment)



Transmission electron micrograph of hyalinocyte of *Penaeus indicus* (10000 X)



Transmission electron micrograph of Semigranulocyte of *Penaeus indicus* (8000 X)



Transmission Electron micrograph of Granulocyte of *Penaeus indicus* (12000 X)

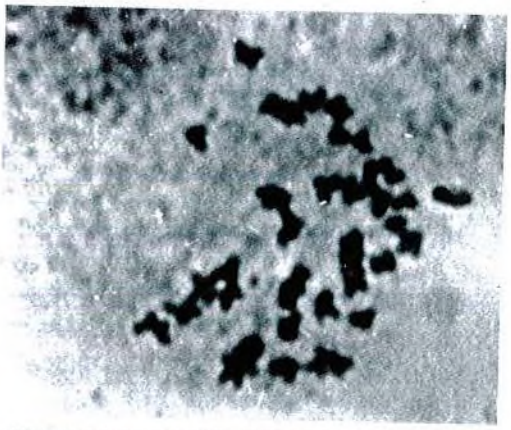
but the semigranulocytes (9.6% in control to 27.05% in treatment) and hyalinocytes (7.38% for control and 12.49% for treated group) increased on exposure to copper.

- The phagocytic index also showed a decrease from 56 in control group to 19.3 in the Cu treated group. Copper, at low concentration (0.1 ppm) acted as a stimulant for endocytic index (0.71 for control and 1.25 for 0.1 ppm Cu.) However at 0.5 and 1 ppm Cu levels the endocytic index values were low, 0.56 and 0.39 respectively. Exposure to 0.1 ppm of copper increased the haemolymph total protein (833.03 mg/ml in 0.1 ppm Cu) as compared to the control (521.13 mg/ml of hemolymph), it significantly reduced the same at higher concentration (402.84 mg/ml of hemolymph at 1 ppm Cu). With respect to the hemolymph protein profile, other than the normal bands of 26 kDa, 31kDa, 74 kDa and 86 kDa no new bands were obtained in treatment group.

- Organophosphate pollutants increased the serum acid phosphatase and lysozyme levels as concentration increased. But heavy metal reduced these enzyme levels. Both the pollutants reduced pro phenol oxidase levels.

FUNDING AGENCY	**ICAR - AP CESS**
PROJECT TITLE	**Induction of Triploidy in commercially important bivalves**
SCIENTISTS	**P.C.Thomas**, P. Muthiah and T.S.Velayudhan
CENTRES	Cochin, Tuticorin

- Triploid edible oysters (*Crassostrea madrasensis)* have been successfully produced using physical and chemical agents. Chemical agents successfully used for induction of triploidy were 6-dimethyl aminopurine and cytochalasin B. They were observed to be efficient in interfering with the meiotic process of the newly fertilized egg leading to the arrest of 2nd polar body expulsion. Exposure of embryos to 6-DMAP at a concentration of 100 mM for a period of 8 minutes commencing from 15 minutes post fertilization was found to be optimum whereas in the case of cytochalasin B, it was 0.05 mg/l concentration for 1 minute.
- Physical agents like cold shock and heat shock of the embryo also resulted in production of triploid oysters. Application of cold shock at 5°C for 10 minutes duration and heat shock of at 37°C for 5 minutes also were found to be optimum for producing triploid oysters. Karyological examination has revealed 30 chromosomes in triploids as against 20 in the diploid controls.



Metaphase spread of triploid edible oyster (3N=30)

FUNDING AGENCY	**ICAR – AP CESS**
PROJECT TITLE	**Intensive culture of brine shrimp**
SCIENTISTS	**M. Rajamani**
CENTRE	Tuticorin

Culture of the brine shrimp in race way system was initiated at Tuticorin.

Six experiments were conducted in one ton FRP tank with the native species *A. parthenogenetica* and four with the exotic species *A. franciscana.*

FUNDING AGENCY	**DEPARTMENT OF FISHERIES, GOVT. OF KERALA**
PROJECT TITLE	**Survey, assessment and breeding of marine ornamental fish along the North Malabar coast**
SCIENTISTS	**K.K. Philippose**
CENTRE	Calicut

About 40 species of marine ornamental fishes were observed in the fishery in these region during October-May.

Neopomacentrus filamentosus was abundant along the Dharmadom-Chombal sector. *Gymnothorax* sp. was available in good numbers

along the Elathur-Chombal sector. *Scatophagus sp.* was observed in abundance in the estuarine system. *Siganus spp., Ostracion cubicus, Diodon histrix* and *Arthron hisphidous* were found in large numbers in the trawl catches.

FUNDING AGENCY	**DEPARTMENT OF FISHERIES, GOVT. OF KERALA**
PROJECT TITLE	**Development of artificial reef off Dharmadom**
SCIENTISTS	**K.K. Philippose**
CENTRE	Calicut

Dharmadom near Calicut was selected for the installation of the reef. A series of group meetings were held between fishermen and two classes were conducted with the use of audio visual aids to create the awareness about the benefits of artificial reef.Triangular modules of 5x5x5 size with 2 window on the side slabs were deployed during 1st to 6th April, 2000.

During May 2000 to September 2000 a total of 264 of fishes were caught by gill nets from the Dharmadom area. The catch rate for the period was worked out to be 121.9 kg/unit for the period. *Sardinella longiceps* (172 t), *Rastrelliger kanagurta* (45 t), *Ambassis* spp (14 t) and *Gerres filamentosus* (5 t) were the major species.

FUNDING AGENCY	**DEPARTMENT OF FISHERIES, GOVT. OF KERALA**
PROJECT TITLE	**Development of artificial reef off Moodadi and Thikkodi**
SCIENTISTS	**K.K. Philippose**
CENTRE	Calicut

Triangular modules of 5'x5'x5 size using 1.5" thick concrete slabs are being fabricated for both the reefs. Each slab is provided with a middle window of 2'. Both the reefs are planned close to the natural reefs so that in future the new reef will act as a continuation of the existing reef.

NATIONAL AGRICULTURAL TECHNOLOGY PROJECT

Collaborative research programmes with other Institutes like CIFT, CARI, CIBA, KKV, Ratnagiri and GAU, Sikka have been undertaken under the National Agricultural Technology Project funded by the World Bank

FUNDING AGENCY	**NATP**
PROJECT TITLE	**Breeding and culture of pearl oysters and production of pearls**
SCIENTISTS	**K.K. Appukuttan** , K.S.Mohamed, T.S.Velayudhan, V.Kripa, A.C.C. Victor, A. Chellam, S.Dharmaraj, P. Laxmilatha and Shoji Joseph
CENTRES	Cochin, Tuticorin
COLLOBORATING INSTITUTES	**CIFT Cochin, CARI Port Blair and GAU, Gujarat**

For refinement of open sea farming systems and spat collection from the wild, 2 conventional bamboo rafts were deployed. One raft was deployed at Narakkal (off Cochin), a typical open sea condition, and another at Port Kollam, an artificially protected bay. At

Narakkal 219 spawning stock and 321 spats were suspended from the raft. At Port Kollam, 505 adult spawnintg stock were suspended from the raft. During January under these two diverse conditions, the following experiments are being carried out.

1. Testing the use of relatively lesser weight (23 kg) Danforth anchors, instead of the Conventional Grapnel anchors (35-45 kg).
2. Testing different stocking cages and stocking densities.
3. Testing of different spat collectors.

In the experiments on tissue culture of pearl oysters, incorporation of body fluid extracts with medium 199 promoted good cell poliferation and increased longevity of the culture. Cell proliferation was better in depurated oyster mantle rather than in non-depurated oyster mantle. Cell disassociation was high when treated with 4000 µg of streptomycin and 8000 µg of pencillin. Organ cultures of pearl oyster mantle resulted in secretion of crystal-like substances.

A workshop on Pearl Mariculture was held at Vizhinjam during 10-11 October and 16 participants were given training in all aspects of pearl culture by mooring a demonstration raft. During the workshop, participants, mainly coastal fishers from nearby panchayats, were trained in fabrication of grow-out structures like rafts and cages. Oysters brought from Tuticorin were suspended in newly designed book cages from this raft for making growth studies.

Collaborative programmes with CIFT, Cochin CARI, Port Blair and Gujarat Agricultural University was continued.

FUNDING AGENCY	**NATP**
PROJECT TITLE	**Nutrition and Pathology in Mariculture**
SCIENTISTS	**R. Paul Raj** ,Manpal Sridhar, K.C. George, D.C.V.Easterson, M. Vijayakumaran, A.P.Lipton
CENTRES	Cochin, Chennai and Vizhinjam
COLLOBORATING INSTITUTES	**CIFT Cochin, CARI Port Blair and TANUVAS,Tuticorin**

- Survey of mud crab farming facilities in the coastal area of Kerala to study the culture and feeding practices indicated the lack of scientific feed management. Feeding is carried out using locally available dry fish, salted fish, fresh fish & clam meat without proper assessment of the utility of these for the survival as well as biomass production.
- In order to evaluate the nutritive value of some of the locally available fresh natural feeds (sardines, anchovies and clam meat) feeding trials were carried out in crabs of 50-400 g size. Feeding the crabs exclusively on frozen sardines and anchovies resulted in malformation of walking appendages and in some newly moulted crabs, total loss of some of the appendages is also observed.
- Unconsumed feeds in the crab rearing tanks resulted in increased ammonia level and low dissolved oxygen levels causing moralities.
- With the view to evaluating the efficacy of compounded feed, a pellet feed (protein-43.33 % and lipid- 8.53 %) and a semi-moist gel feed (protein-50.53 % and lipid-9.85 %) were prepared. The feeding trials indicated that the smaller crabs (50-80 g) easily accept the feed than the larger ones (200-400 g). The gel steaks prepared with agar binder was found to have better hydro-stability than the pellet with guar gum as binder.
- Experiments on fermentation of soybean flakes and flour using, *Bacillus coagulans* resulted in breakdown of crude fibre and

about 5 % increase in NFE.

- About 50-60 % of infections, in spiny lobster, *Panulirus homarus* reared in holding facilities for live transport were bacterial in nature. *Vibrio parahaemolyticus* has been isolated from gills, carapace of lobsters as well as from phyllosoma larvae. The occurrence of several other *Vibrio* species has been recorded and their identity requires confirmation.
- *Vibrio* species have also been recorded from gills, legs and outer body surface of mud crab. *Vibrio parahaemolyticus* has been identified.
- Bacterial load in grouper brood-stock facilities and pearl oyster hatchery is being regularly monitored and biochemical characterization of the bacterial isolates is in progress.
- With a view to studying the effect of aflatoxins, pure strain of *Aspergillus falvus* has been cultured for the production of biomass and extraction of aflatoxin. The purity of the toxin was tested by HPLC and 96 % of the extract was Aflatoxin B1.
- Survey of commercially available feeds and feed ingredients for the presence of aflatoxin has been initiated and some of the samples of GNOC and shrimp feeds tested positive for aflatoxin.
- Feeding trials for fattening mud crabs at CARI, Port-Blair, using fresh natural feeds like mangrove clam, squid head, and fish showed that the clam meat was the best to promote growth and survival followed by squid head. Those, which were fed on fish, provided very low survival of 66-70 %.

FUNDING AGENCY	**NATP**
PROJECT TITLE	**Mussel Mariculture**
SCIENTISTS	**T.S.Velayudhan**, V.Kripa K.K. Appukuttan , K.S.Mohamed, R.Sarvesan, P.V.Sreenivasan, P. Laxmilatha, P.K.Asokan and Geetha Sashikumar
CENTRES	**Cochin, Chennai and Mangalore**
COLLOBORATING INSTITUTES	**KKV Ratnagiri and CARI Port Blair**

As a prelude to mapping of site suitable for mussel farming and preparation of mussel seed calendar, a preliminary database was obtained by sending an enquiry form to field survey staff of CMFRI stationed along the maritime states. It cound be inferred that the maritime states Kerala, Karnataka, Goa and Tamilnadu have rich mussel resource whereas at Maharastra and Andra Pradesh it is moderate . Along Gujarat and Orissa only negligible quantity has been reported.

- The total brown mussel seed in Tamil Nadu was estimated as 680 in 37500 sq.m.area.
- Though green mussel beds were observed in Vellar and Thenpakkam estuaries the seed availability was noted only in one estuary during the period October 2000 to April 2001.
- Mussel resource in Pondichery (not fully covered) was estimated as 37 in Thengaithittu estuary in 1,16,200 sq.m area.
- Along southern Andra coast in Kandaleru estuary, the mussel biomass was estimated as 2.5 in 1740 sq.m.
- The mussel resource of Andamans was estimated as 14221 covering an area of 1980 sq.m
- The main areas in Anadamans with mussel resource were identified as Minnie Bay,

Hathitope and Mithagiri.

- In Maharastra, the transfer of technology programme was initiated.
- Demonstration farms were set up in Juva Village and the fishers were trained in mussel farming techniques. Awareness programmes were conducted in the coastal villages.
- Pamphlets on mussel farming were prepared in the local language (Marati) and distributed to the fishers.

FUNDING AGENCY	**NATP**
PROJECT TITLE	**Agricultural Technology Information Centre (ATIC)**
SCIENTISTS	**R. Sathiadas** and Sheela Immanuel
CENTRE	Cochin

An Agricultural Technology Information Centre (ATIC) was sanctioned during December 1999 under the National Agricultural Technology Project (NATP). The required furniture and equipment are purchased and the ATIC cell is functioning in the SEETT Division as a temporary arrangement till the renovation work of the building is completed.

The work on updating of pamphlets and brochures are underway. Necessary action was initiated to undertake all the sales/services/ products through Single Window Delivery system under the ATIC of the Institute. An amount of Rs 5.47 lakh was generated during the year through the sales of pearls, mussels & shrimps (Rs.3.84 lakh) and Institute publications (Rs.1.13 lakh).

FUNDING AGENCY	**NATP**
PROJECT TITLE	**Institute-Village-Linkage-Programme(IVLP)**
SCIENTISTS	**R.Sathiadas,** Sheela Immanuel, L.Krishnan, A.Lakshminarayan and D.Noble.
CENTRE	Cochin

The CMFRI is one of the Institutes identified by ICAR to undertake the Technology Assessment and Refinement (TAR) through Institute-Village-Linkage- under the coastal agro-eco system. Elankunnapuzha village of Vypeen Island in Ernakulam District has been selected for implementing this programme on the basis of the recommendations of a multi-disciplinary core team.

The Elankunnapuzha village represents the typical and unique coastal topography of west coast of India, which is congenial for techno-intervention of capture and culture fisheries, agro-horticulture and animal husbandry. The Institute had identified 30 well defined action programmes to be implemented in a phased manner in this village.

The first Site Committee meeting was held on 8-12-2000 discussed this programme in detail and cleared 20 techno-interventions to be carried out in phase I. Out of these, nine are agriculture based, three are livestock based and eight are fisheries based techno interventions. A total of 211 beneficiaries have been identified for implementing these interventions comprising 120 for agriculture based, 56 for livestock based and 35 for fisheries based programmes. The necessary schedules for data collection and required linkages have been developed with the State Departments of Agriculture, Animal Husbandry, Fisheries, State Agricultural University, CIFT, CPCRI, CTCRI, and several NGOs to facilitate the smooth implementation of the techno-interventions.

EDUCATION AND TRAINING

POSTGRADUATE PROGRAMME IN MARICULTURE

Highpower Committee from Mangalore University in discussion with the Director regarding recognition of CMFRI for Ph.D work

Ph.D. Programmes

- 2 students have been awarded Ph.D. Degree in Mariculture by the Central Institute of Fisheries Education (CIFE), Mumbai
- 5 students have submitted their Ph.D. theses for adjudication to CIFE during the year and the results are awaited
- One student has submitted the Ph.D. thesis to Cochin University of Science & Technology (CUSAT) for adjudication and the result is awaited
- 17 Ph.D. students of the CUSAT stream and 30 Ph.D. students under the Postgraduate Programme in Mariculture under the CIFE stream are progressing with their research/course work

M.F.Sc.

- 8 students have successfully completed the M.F.Sc. course in Mariculture and were awarded Degree by CIFE during the year

PGPM Accreditation

- A self study report has been prepared and submitted to the CIFE for accreditation of the M.F.Sc. and Ph.D. Programmes in mariculture

KRISHI VIGYAN KENDRA

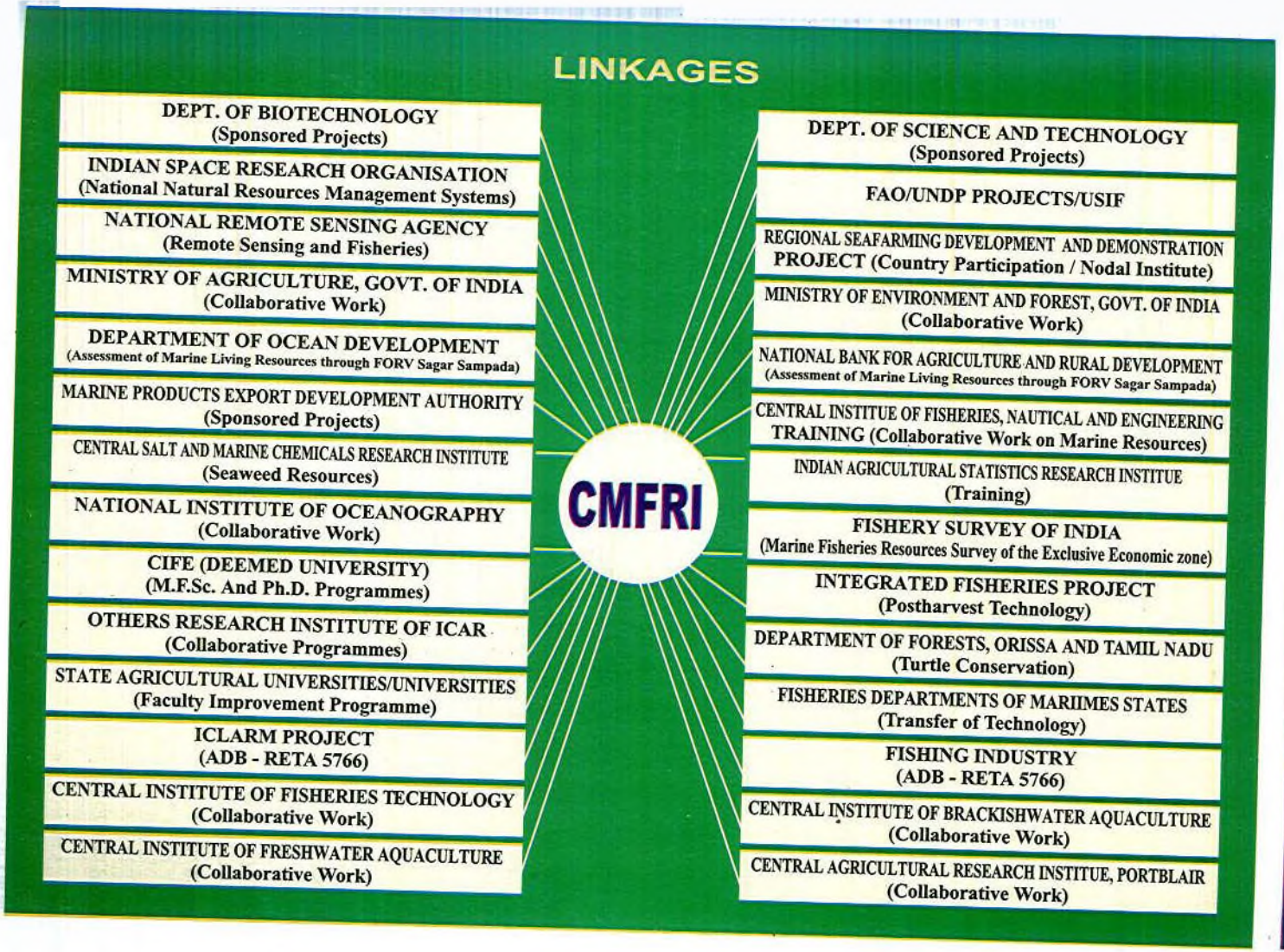
The Krishi Vigyan Kendra conducted 64 training programmes during 2000 and the details are given below:

Sl.No	Discipline/ Course	Duration (days)	No. of courses Conducted	No. of persons trained			
				Male	Female	Total	SC
1.	**Fisheries**						
	a) Prawn farming	3	7	142	18	160	48
	b) Prawn farming	2	8	116	40	156	67
	c) Prawn farming	1	2	21	10	31	4
	d) Ornamental fish culture	2	1	-	14	14	1
	e) Ornamental fish culture	1	1	19	15	34	-
2.	**Agriculture/ Horticulture**						
	a) Vegetable cultivation	2	6	40	78	118	11
	b) Mushroom cultivation	2	6	3	141	144	18
	c) Mushroom cultivation	1	3	78	26	104	-
	d) Banana cultivation	2	1	11	9	20	-
	e) Integrated rodent con-ol in coconut farm	1	1	4	16	20	-
3.	**Home Science**						
	a) Fruit preservation	2	8	1	223	224	33
	b) Fruit preservation	1	12	19	191	210	9
	c) Food and Nutrition	2	2	-	49	49	-
	d) Food and Nutrition	1	1	-	13	13	4
	e) Tailoring	3	1	-	11	11	-
	f) Preparation of cleaning powder	1	3	-	43	43	4
	TOTAL		**64**	**326**	**915**	**1369**	**219**

TRAINERS' TRAINING CENTRE

During the period, ten short term training courses were organised availing the expertise at CMFRI. The Courses were conducted at Cochin, Calicut, Vizhinjam, Mangalore & Puthuponnani. Rs. 1,21,000 was collected towards course fee during the year. The details of training programmes conducted are given below:

Sl.No	Title of the Course	Month	No. of days	No. of Participants
1.	Mussel Farming	January November	1 1	46 20
2.	Live Feed Culture	February-March	4	19
3.	Ornamental Fish Culture	February-March June July October November	5 6 6 6 6	17 20 21 16 16
4.	Finfish & Shellfish Disease Investigations.	August	11	8
5.	Seaweed Culture and Utilization	November	10	7
Total number of courses conducted		10		
Total number of participants		**190**		


LINKAGES
DEPT. OF BIOTECHNOLOGY (Sponsored Projects)
INDIAN SPACE RESEARCH ORGANISATION (National Natural Resources Management Systems)
NATIONAL REMOTE SENSING AGENCY (Remote Sensing and Fisheries)
MINISTRY OF AGRICULTURE, GOVT. OF INDIA (Collaborative Work)
DEPARTMENT OF OCEAN DEVELOPMENT (Assessment of Marine Living Resources through FORV Sagar Sampada)
MARINE PRODUCTS EXPORT DEVELOPMENT AUTHORITY (Sponsored Projects)
CENTRAL SALT AND MARINE CHEMICALS RESEARCH INSTITUTE (Seaweed Resources)
NATIONAL INSTITUTE OF OCEANOGRAPHY (Collaborative Work)
CIFE (DEEMED UNIVERSITY) (M.F.Sc. And Ph.D. Programmes)
OTHERS RESEARCH INSTITUTE OF ICAR (Collaborative Programmes)
STATE AGRICULTURAL UNIVERSITIES/UNIVERSITIES (Faculty Improvement Programme)
ICLARM PROJECT (ADB - RETA 5766)
CENTRAL INSTITUTE OF FISHERIES TECHNOLOGY (Collaborative Work)
CENTRAL INSTITUTE OF FRESHWATER AQUACULTURE (Collaborative Work)
CMFRI
DEPT. OF SCIENCE AND TECHNOLOGY (Sponsored Projects)
FAO/UNDP PROJECTS/USIF
REGIONAL SEAFARMING DEVELOPMENT AND DEMONSTRATION PROJECT (Country Participation / Nodal Institute)
MINISTRY OF ENVIRONMENT AND FOREST, GOVT. OF INDIA (Collaborative Work)
NATIONAL BANK FOR AGRICULTURE AND RURAL DEVELOPMENT (Assessment of Marine Living Resources through FORV Sagar Sampada)
CENTRAL INSTITUE OF FISHERIES, NAUTICAL AND ENGINEERING TRAINING (Collaborative Work on Marine Resources)
INDIAN AGRICULTURAL STATISTICS RESEARCH INSTITUE (Training)
FISHERY SURVEY OF INDIA (Marine Fisheries Resources Survey of the Exclusive Economic zone)
INTEGRATED FISHERIES PROJECT (Postharvest Technology)
DEPARTMENT OF FORESTS, ORISSA AND TAMIL NADU (Turtle Conservation)
FISHERIES DEPARTMENTS OF MARIIMES STATES (Transfer of Technology)
FISHING INDUSTRY (ADB - RETA 5766)
CENTRAL INSTITUTE OF BRACKISHWATER AQUACULTURE (Collaborative Work)
CENTRAL AGRICULTURAL RESEARCH INSTITUE, PORTBLAIR (Collaborative Work)

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CONSULTANCY, PATENTS, COMMERCIALISATION OF TECHNOLOGY

Completed Consultancy Projects during 2000-01

Sl.No	Client	Amount in Rs.	Type of projects
1	Kuderemukh Iron Ore Co.Ltd, Mangalore . (Phase III).	3,80,000	Consultancy
3	Mangalore Refinery & Petrochemicals Ltd., Mangalore. (Phase IV).	6,64,000	Consultancy
3	Integrated Tourism Promotion Council, Kannur	2,20,000	Consultancy
4	Beharin Society of pearls and Oysters, Beharin	8,21,340	Training

Ongoing Consultancy Projects During 2000-01

Sl. No	Client	Amount in Rs.	Type of projects
1	Kuderemukh Iron Ore Co.Ltd, Mangalore .(Phase IV).	3,80,000	Consultancy
2	Centre for Marine Analytical Reference & Standards,Trivandrum	2,77,000	Consultancy
3	Mangalore Refinery & Petrochemicals Ltd., Mangalore. (Phase V).	6,64,000	Consultancy
4	Mangalore Refinery & Petrochemicals Ltd., Mangalore. (Emergency).	15,00,000	Consultancy
5	Indian Tropical Agro-products(P)Ltd, Tuticorin	96,000	Consultancy
6	Andhra University, Visakhapatanam.	20,000	Contract service

QRT, RAC, MANAGEMENT COMMITTEE AND SRC MEETINGS

Quinquennial Review Team

The ICAR constituted the Quinquennial Review Team (QRT) consisting of:

(1) Dr. S.D. Tripathi, Former Director, CIFE - Chairman

(2) Dr. D. Sudarsan, Former DG, FSI - Member

(3) Dr. K. Muralidhar, Professor of Zoology, Delhi University - Member

(4) Dr. N.C. Ganguli, Former Secretary, MAAS, Delhi - Member

(5) Dr. M.N. Kutty, Formerly of FAO, NACA - Member

(6) Dr. V.S.R. Murty, Head DFD, CMFRI - Member Secretary

(7) Dr. A.D. Diwan, ADG (M.Fy.), ICAR - Co-ordinator

The team visited Headquarters and Visakhapatnam, Kakinada, Chennai, Tuticorin, Mandapam Camp, Vizhinjam and Bombay Centres and reviewed the work of the Institute during the period 1994-1999.

RESEARCH ADVISORY COMMITTEE

List of members

Dr. N. Balakrishnan Nair - Chairman

Dr. Uma Maheswara Rao - Member

Dr. K. Radhakrishna - Member

Dr. N.R. Menon - Member

Dr. M.S. Johal - Member

Dr. M. Mohan Joseph - Member

Dr. V.K. Pillai/ Dr. V.S.R. Murty - Member Secretary

The Research Advisory Committee meeting was held on 21-12-2000 at the Headquarters of the Institute. The Committee made the following recommendations

1. *Ad hoc projects*: Scientists should propose *Ad hoc* projects in areas relevant to their nodal Division only to improve expertise in the concerned division besides creating a healthy competition among divisions of the Institute.

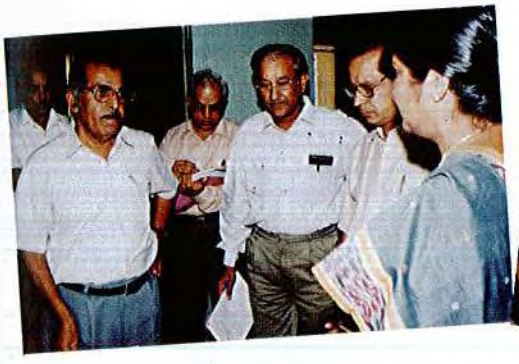
2. *Landing of young fish*: In view of the reported landings of juveniles of several commercially important species, each research project in capture fisheries should ensure data on juveniles which are landed as trash fish; only then, the sampling of landings of a particular resource would be complete.

3. *Discards*: To immediately develop a mechanism to generate data on the quality and quantity of discards, their possible utilization and implement the same in view of the reports on large scale discards by the mechanized vessels, particularly the large trawlers, and the paucity of data on discards.

4. *Taxonomy*: It was observed that there is continuous and fast depletion of taxonomists in almost all groups of marine organisms in the country which could lead to undesirable consequences if proper steps

VISIT OF QRT MEMBERS TO HEADQUARTERS








QRT AT KAKINADA, TUTICORIN AND CHENNAI RESEARCH CENTRES AND MANDAPAM REGIONAL CENTRE

are not taken to develop HRD in this area. Currently the nation is giving thrust to biodiversity conservation and equitable sharing of the benefits. Without expertise in taxonomy, it is not possible to address the issues of marine biodiversity effectively. The RAC therefore recommendedthat the institute should attach due importance to taxonomy by making it a part of the research projects in capture fisheries.

5. *Basic research*: Basic research in different areas of biology of finfish and shellfish needs to be strengthened and continued concurrently with applied research.

6. *Stock assessment*: The CMFRI has all required data and expertise in Stock assessment. Hence this work has to be carried out every year and reported. For this purpose a working group should be constituted to take the responsibility of pooling the data of different resources, analyze the same and prepare the report. The RAC also recommended that the Institute should focus its attention on predictive models

7. *Frame survey*: The RAC noted with concern that the Frame survey of fishermen population, craft, gear etc. has not been conducted over the past twenty years. the Institute should speed up its efforts to implement this work and bring out the results on a top priority basis.

8. *Multidisciplinary approach*: The RAC recommended that the projects in mariculture should be recast to involve specialists (e.g. biology, environment, physiology, biochemistry, nutrition and pathology) in different areas by identifying the work to be done. The outcome of such research should be discussed and steps to fill the gaps should be taken to finally develop a technology package.

9. *Mollusc mariculture*: The RAC noted that this research is largely restricted to Kerala with small programmes undertaken in Tamilnadu. Now that the technologies for breeding, larval rearing and growout culture are developed and suitable sites along the country's coast are identified, it is necessary to implement demonstration/ research programmes in other coastal areas of the Nation.

10. *Pearl culture*: The RAC noted that this work is carried out only in Tamilnadu. It has to be taken to other states and in the open sea. Research on tissue culture and production of pearls of different colours should be initiated and strengthened. Focused attention to be given to pearl culture in blacklip pearl oyster.

11. *Finfish culture*: Though success has been reported in breeding the groupers, considerable effort has to be put in to understand the mechanism of sex-reversal, maturation and spawning in confinement. There is also need to urgently develop the technology of hatchery production of seed of groupers. The research carried out in ornamental fish culture has to be consolidated, gaps if any, to be filled up and technology package given out.

12. *Centre of Excellence in Mariculture*: Noting that the Mandapam Regional centre is placed suitably for mariculture research and facilities for carrying out research on majority of marine organisms built up at this centre, the RAC recommended that this Regional centre should be developed into a "Centre of Excellence in Mariculture" by posting scientists in all required disciplines/ subjects and by creating the required additional facilities and infrastructure.

13. *Crustacean culture*: Recommended that the research effort on hatchery production of seed of crab should be scaled up to develop this technology package.

14. *Research Centres*: The research centres should continue to work on fisheries of national importance as is done now but should simultaneously develop specialization around each centre to be able to address the regional research needs.

15. *Need to cut down the number of projects*:. Care should be taken to see that the Institute does not duplicate its projects with sponsored projects and review has to be conducted on other projects and wind up unproductive projects

16. *Fishery Environment*: The fishery environmental data have to be utilized to forecast the catches or to forecast the availability and abundance in different regions in the country's EEZ. It is necessary to generate all required environmental data using the institute's vessels or such data should be acquired from other agencies like NIO where the Oceanographic Data Centre exists.

17. *Seaweed Research*: The Institute should give priority attention to develop next line of leadership in seaweed research. The RAC recommends that highly productive regions for seaweeds have to be identified and the quantities of biomass estimated species wise. Tissue culture of important species should be undertaken.

18. *Need Analysis*: There is need for the Institute to take up need-based research (both long-term and short-term) on the basis of discussions with the stakeholders. The RAC recommended that the institute should interact with all stakeholders before formulating new research projects.

INSTITUTE MANAGEMENT COMMITTEE

List of members

Dr. M. Mohan Joseph, Director	-	Chairman
Dr. A.D. Diwan, ADG (MF), ICAR	-	Member
Dr. V.S.R. Murty, Head, DFD	-	Member
Dr. N. Gopalakrishna Pillai, Head, PFD	-	Member
Dr. K.K. Appukuttan, Head, MFD	-	Member
Dr. P.A. Thomas, Sr. Scientist	-	Member
Shri P.S. Sudersanan, Adm. Officer	-	Member Secretary

The Management Committee Meetings were held on 17.3.2000 and 18.10.2000 and the following recommendations were made:

1. Nomination of Dr. K.K. Appukuttan, Head of Division, MFD as member of the Institute Grievance Committee was approved.

2. Re-appropriation of funds for the year 1999-2000 under Plan and Non-Plan was approved

3. The Committee approved the proposal for creating the facility of guest house for CMFRI by converting its Type VI quarters, purely on temporary basis subject to ratification from the Council.

4. The proposal for commencement of the construction of V & VI floor of the existing CMFRI Headquarters Lab-cum-Office building during the IX Plan period based on the EFC approval was considered and approved

5. The proposal for inclusion of the item of construction of a sea wall for the Fish

Farms at Mandapam Regional Centre of CMFRI in the IX Plan documents was approved

6. The IMC approved purchase of (i) one LCD Projector, (ii) one Lap-top Computer and (iii) two Audio Visual touch screen display for dissemination from the funds provided under the sub-head 'Information Technology' amounting to Rs. 9.00 lakh

7. Proposal for condemnation of Jeep No. MSM 9012 (Willys jeep) of Tuticorin Research Centre of CMFRI was approved.

STAFF RESEARCH COUNCIL

The SRC meeting of the Institute was held on 22nd & 23rd June 2000 and the progress on the ongoing projects was discussed.

PARTICIPATION OF SCIENTISTS IN CONFERENCES, MEETINGS, WORKSHOPS, SYMPOSIA AND TRAINING IN INDIA AND ABROAD

Name & Designation	Symposium/ Seminar/ Workshop/ Conference	Organised by	Place	Date/s
Dr. Mohan Joseph Modayil Director	National Workshop on The Code of Conduct for Responsible Fisheries	Bay of Bengal Programme	Chennai	September 29-30, 2000
	EFC discussions on the X Plan proposal of CMFRI	National Bureau of Fish Genetic Resources	Lucknow	October 9, 2000
	ICAR Directors' Conference	Indian Council of Agricultural Research	New Delhi	October 12-14, 2000
	Meeting on Revalidation of Potential Marine Fish Yield	Fishery Survey of India	Mumbai	October 19, 2000
	Brainstorming Session on Manpower Requirements and HRD in Fisheries Sector under the AHRD Programme of Education Division, ICAR	Central Institute of Fisheries Education	Mumbai	October 20-21, 2000
	National Seminar on 'Sustainable Fisheries for Nutritional Security'	Indian Bank Management Academy (IMAGE)	Chennai	November 29 to December 2, 2000
	XXVII meeting of the Academic Council	Central Institute of Fisheries Education	Mumbai	December 14, 2000

	V[th] Convocation of CIFE	Central Institute of Fisheries Education	Mumbai	December 15,2000
	Chaired the Session on Problems and Prospects of Environment in the New Millennium	Mangalore University	Mangalore	December 16, 2000
Dr. V.Sriramachandra Murty Head of Division	Meeting of the Group on Marine Bioresources	Dept. of Ocean Development	New Delhi	March 1, 2000
	Meeting of the Task Force on Stock Assessment of Deep Sea Fishery Resources	-do-	Mumbai	March 3, 2000
	Meeting on comprehensive Marine Fisheries Policy	Ministry of Agriculture, Govt. of India	New Delhi	March 30, 2000
	Subgroup meeting of the Working Group on Revalidation of Potential Marine Fishery Resources	-do-	Mumbai	April 12, 2000
	Fourth meeting of the Committee on Comprehensive Marine Fisheries Policy	-do-	Visakha-patnam	July 19, 2000
	Meeting of the Working Group on Revalidation of Potential Marine Fishery Resources in the Indian EEZ	-do-	Cochin	October 4, 2000
	Meeting of the Working Group	-do-	Mumbai	October 19, 2000

	on Revalidation of Potential Marine Fishery Resources in the Indian EEZ			
	Meeting of the Task Force on Marine Bioresources DBT/DOD	DOD	Cochin	November 7-8, 2000
	Meeting of the Coastal Zone Management Authority of Government of Kerala	Kerala Government	Trivandrum	December 22, 2000
	Fifth meeting of the Committee on Comprehensive Marine Fisheries Policy	CIFT	Cochin	December, 2000
Dr. R. Sathiadhas Head of Division	Technology Assessment and Refinement (TAR) through Institute -Village-Linkage-Programme (IVLP) Interaction Workshop	Central Institute of Brackishwater Aquaculture	Chennai	March 17-18, 2000
	Project Proposal Preparatory Meeting Under the Specific Programme for Research, Technological Development and Demonstration of the European Commission	Nansen Environmental Research Centre, India (NERCI)		August 24-25, 2000
	Project Development Workshop, to present a proposal entitled	Environmental Economics Research Committee, Indira Gandhi	Mumbai	September 12-13, 2000

	Environmental Economic Analysis of Inshore Fishery Resource Utilisation of Coastal Kerala	Institute of Development Research		
	Launching Workshop- cum orientation for Agricultural Technology Information Centres (NATP)	Central Research Institute for Dry land Agriculture	Hyderabad	October 18-19, 2000
Dr. R. Narayana Kumar Scientist	National Conference on Fisheries Economics, Extension and Management	Central Institute of Fisheries Education	Mumbai	January 5-6, 2000
	Faculty Upgradation Programme Post-Graduate Faculty	Madras School of Economics	Chennai	September 4-29, 2000
	Net Working of Social Scientists	National Centre for Agricultural Economics and Policy	Madras Veterinary College, Chennai	December 27, 2000
Smt. Sheela Immanuel Scientist	Seminar on Rural Fish Marketing in India	Fisheries College and Research Institute	Tuticorin	September 11-13, 2000
	Annual Review Meeting of TOT Projects of Kerala and Lakshadweep	KVK Central Plantation and Tuber Crops Research Institute (CPCRI)	Kasargod	October 23-24, 2000
Dr. R. Paul Raj Head of Division	Fourth Workshop of NATP Coastal Agro-Eco Systems	Central Marine Fisheries Research Institute	Cochin	January 28-30, 2000

	XXVI Academic Council Meeting	Central Institute of Fisheries Education	Mumbai 15, 2000	July
	Training programme on "Agricultural Research Prioritization Techniques"	NAARM	Hyderabad	August 21-26 2000
	XXVII Academic Council Meeting	Central Institute of Fisheries Education	Mumbai 14, 2000	December
Dr. P.C. Thomas Sr. Scientist	Workshop on Chromosome and Gene Manipulation Techniques in Fishes	Madurai Kamaraj University	Madurai	October 3-24 2000
Dr. P. Jayasankar Scientist (Sr. Scale)	Summer School on Aquaculture Biotechnology	Central Institute of Frershwater Aquaculture	Bhuba-neswar	June 12 to July 3, 2000
	Meeting to Review Progress under Research Projects and Management Action Plans under Biosphere Reserve Scheme	Kerala Forests Research Institute (KFRI)	Peechi	September 8-11, 2000
	National Seminar on Biodiversity Conservation & Management with special emphasis on Biosphere Reserves	Environmental Planning & Coordination Organization	Bhopal	November 24-27, 2000
Dr. K.S. Sobhana Scientist	Summer School on Recent Advances in Marine Biotechnology	Central Institute of Fisheries Education	Mumbai	August 7-27. 2000

	Summer School on Recent Advances in Fish and Shellfish Health Management	College of Fisheries	Mangalore	November 6-25, 2000
Dr. K.K. Appukuttan, Head of Division	Meeting with the Fisheries Secretary and Fisheries Director	Govt. of Kerala	Trivandrum	March 10, 2000
	Expert Committee meeting for the formulation of Fisheries Master Plan for Kerala	Dept. of Fisheries, Govt. of Pondicherry	Trivandrum	May 27-28, 2000
	WTO Sub-Committee meeting	MPEDA	Trivandrum	July 31, 2000
Shri T.S. Velayudhan Sr. Scientist	Fisheries Expert Committee Meeting	Corporation	Cochin	June 2, 2000
Dr.V. Kripa, Sr Scientist	Fisheries Expert Committee Meeting	Corporation of Cochins	Cochin	January 28, 2000
Dr.K. Sunilkumar Mohamed, Scientist (Sr. Scale)	National Seminar on Shrimp Farming		Kodungallore	October 14, 2000
Dr.P.Laxmilatha, Scientist (Sr. Scale)	Clam Farming Training to SHG (women)	Fisheries Dept.	Arookutty	November 16, 2000
Dr.Shoji Joseph, Scientist	Brain Storming Session on Conservation of Endangered Marine Animals and Corals of Gulf of Mannar and Mass Awareness Campaign and Inaugural function	National Bureau of Fish Genetic Resources and Fisheries College and Research Institute	Fisheries College and Research Institute (FC&RI), Tuticorin,	August 10-11, 2000

	of Fishermen Forum for Protection of Our Seas			
Dr. E.V. Radhakrishnan Head, CFD	Training on Senior Level Programme on Agricultural Scientist Development for Personal and Organizational Effectiveness	NAARM	Hyderabad	July 17-27, 2000
	National Seminar on Indian Aquaculture and Coastal Zone Management (in Hindi)	Central Institute of Fisheries Education	Mumbai	September 7-8, 2000
Shri K.P. Said Koya Scientist (Sr. Scale)	Regional meeting of KVKs and TTCs	Kerala Agricultural University	Mannuthy, Trichur	May 14, 2000
	Zonal Workshop of KVKs and TTCs	Krishi Vigyan Kendra, Central Plantation Crops Research Institute	Kasargod	October 28-29, 2000
Shri Joe K. Kizhakudan Scientist	Workshop on Current Situation in Fisheries Sector in Gujarats	Gujarat Institute of Development Research (GIDR)	Ahmedabad	August 4, 2000
	Workshop on Marine Fisheries Research in Gujarat	Gujarat State Fisheries Department	Veraval	September 1-2, 2000
	Workshop in connection with the NATP Funded Project Impact of Dams		CMFRI, Mangalore	December 9-10, 2000

Dr. V.D. Deshmukh Sr. Scientist	Consultative Group Meeting	FSI	Mumbai	January 6, 2000
	International Conference on Probing in Biological Systems	Dept. of Zoology	The Institute of Science, Mumbai	February 7-11, 2000
	Brainstorming Session on Manpower Requirements and HRD in Fisheries Sector	Central Institute of Fisheries Education	Mumbai	October 20-22, 2000
Shri M.Z. Khan Sr. Scientist	XXXIII Consultative Group Meeting	FSI	Mumbai	May 11, 2000
Dr. V.V. Singh Sr. Scientist	National Seminar on Popularisation of Fisheries, Dairying, Poultry and Piggery Vocational Courses	Dairy Sciences Institute,	Mumbai	February 16-18, 2000
	National Seminar on Indian Aquaculture and Coastal Zone Management	Central Institute of Fisheries Education	Mumbai	September 7-8, 2000
Shri P.U. Zacharia Scientist (Sr. Scale)	National Biodiversity Strategy and Action Plan (NNSAP) Meeting as a Member of the Working Group	Mangalore University	Mangalore	August 26,2000
Dr. P.K. Krishnakumar Scientist (Sr. Scale)	Training programme on Coastal Zone Management	Indian Council of Agricultural Research	College of Fisheries, Mangalore	January 10-19, 2000

Shri A.P. Dineshbabu Scientist	Training on Microsoft Office 97 (1)	Indian Agriculture Statistics Research Institute	New Delhi	January 31 to February 5, 2000
Dr. A.P. Lipton Sr. Scientist	National Seminar on Marine Biodiversity	ICAS	Nagercoil	March 25-26, 2000
	Summer Institute on Principles & Methodologies in Marine Biotechnology	ICAS	Nagercoil	May 22 to June 11, 2000
Smt. K.N. Saleela Scientist	National Seminar on Sustainable Fisheries for Nutritional Security	Madurai Kamaraj University	Madurai	November 29 to December 2, 2000
Dr. M.Rajamani Sr. Scientist	National Seminar on Sustainable Fisheries for Nutritional Security	National Academy of Agricultural Sciences and Madurai Kamaraj University	Chennai	November 30 to December 2, 2000
Smt. P.S. Asha Scientist	International Training Workshop on Methodologies for the Assessment of Biodiversity in Estuaries, Mangroves and Coastal Waters	CAS in Marine Biology, Annamalai University	Parangipettai	March 2-16, 2000
Dr. H. Mohamad Kasim Sr. Scientist	Workshop on Conservation of Turtles	Wild Life Institute of India, Dehradun with Smith Sonien Institute	Rajahmundry	February 21, 2000
	Workshop on Biotechnology Based Programmes for Women and Rural Development	Department of Biotechnology, New Delhi	Kakinada	October 19-20, 2000
	Seminar on Wetland, Ecology, Economy and Sustainability	Department of Zoology, S.K.R. College	Rajahmundry	October 28, 2000

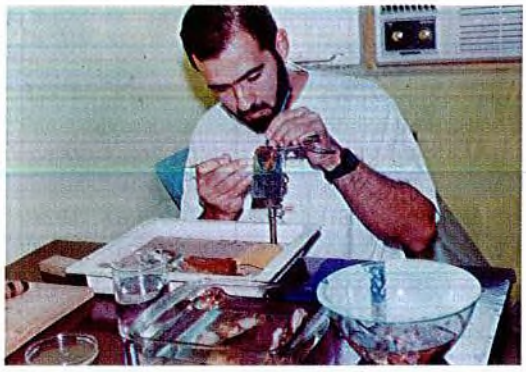
Dr. M. Vijayakumaran Sr. Scientist	Meeting on Lobster Conservation	Marine Products Export Development Authority	Cochin	May 23, 2000
	Meeting on Lobster Conservation with the Lobster Exporters of Maharashtra & Gujarat	Marine Products Export Development Authority, Cochin	Mumbai	July 17, 2000
	Meeting on Lobster Conservation with the Lobster Exporters of Tamil Nadu	Marine Products Export Development Authority	Cochin	July 21, 2000
	Seminar on Chromatography and Water Quality Measurement	EMERCK	Taj Coromandel, Chennai	August 31, 2000
Shri M. Sivadas Scientist (Sr. Scale)	Wild life Celebrations	Science and Technology	Minicoy	October 7, 2000
	Kisan mela	CPCRI Regional Centre	Minicoy	November 20-23, 2000
Dr. P. Nammalwar, Sr. Scientist	Workshop on the application of food quality and safety measures including HACCP principles in food industry	Export Inspection Council of India, Ministry of Commerce and FAO	Chennai	January 29-31, 2000
	Workshop/ Seminar and Techniques in Environmental Toxicology	Postgraduate Institute of Basic Medical Sciences, University of Madras	Chennai	March 20-22, 2000

	Regional Seminar on Productivity of Coral reefs in Gulf of Mannar	Post graduate Department of Zoology, Kamraj College	Tuticorin	March 11-12, 2000
Dr. T.M. Yohannan Sr. Scientist	Sastra Sangamam Organizing Committee meeting		Calicut	April 11-12, 2000
Dr. P.P. Pillai, Dr. N.G.K. Pillai, Dr. K.K. Appukuttan, Dr. R. Paul Raj, Dr. R. Sarvesan, Dr. M. Vijayakumaran, Dr. P. Nammalwar, Dr. G. Syda Rao, Shri D.C.V. Easterson, Shri S. Dharmaraj, Shri M. Sivadas, Dr. Manpal Sridhar and Dr. H. Mohamed Kasim	Symposium on Ecofriendly Mariculture Technology Packages – An Update	Marine Biological Association of India and Central Marine Fisheries Research Institute	Mandapam Camp	April 25-26, 2000
Dr. V.S.R. Murty, N.G.K. Pillai, Dr. R. Sathiadhas, Shri K.N. Kurup, Dr. M. Srinath, Dr. E.V. Radhakrishnan, Dr. E. Vivekanandan and Mrs. Sheela Immanuel	National Consultative Planning Workshop of the Project ADB-RETA 5766 : Sustainable Management of Coastal Fish Stocks in Asia	ICLARM/ CMFRI	Cochin	August 1-3, 2000
Dr. N.G.K. Pillai, Dr. R. Sathiadhas, Dr. P.N.R. Nair, Dr. S. Sivakami, Dr. L. Krishnan, Dr. P. Jayasankar and Shri P.U. Zacharia	National Workshop on Impact of Trawling on Sea Bottom Ecology and Effectiveness of Monsoon Trawl Ban on Rejuvenation of Fish Wealth	Cochin University of Science and Technology	Cochin	August 7, 2000
Dr. P.P. Pillai,	National Workshop	Central Marine	Cochin	September

Dr. V.S.R. Murty Dr. N.G.K. Pillai, Dr. K.K. Appukuttan, Dr. P.N.R. Nair, Dr. S. Sivakami Dr. C. Muthiah, Dr. Manpal Sridhar Dr. V. Kripa, Dr. K. Sunilkumar Mohamed Smt. U. Ganga and Shri T.S. Balasubramanian	on Scombroids	Fisheries Research Institute		19-20, 2000
Dr. K.K. Appukuttan, Shri S. Dharmaraj, Dr. V. Kripa, Dr. K. Sunilkumar Mohamed and Dr. P. Laxmilatha	First NATP Workshop on Pearl Mariculture	Central Marine Fisheries Research Institute	Cochin	February 28-29, 2000
Dr. K.K. Appukuttan, Shri S. Dharmaraj, Dr. K. Sunilkumar Mohamed and Dr. P. Laxmilatha	Second NATP Workshop on Pearl Mariculture	Central Marine Fisheries Research Institute	Vizhinijam	March 29-30, 2000
Dr. V. Kripa and Dr. Shoji Joseph	Third NATP Workshop on Pearl Mariculture	Central Marine Fisheries Research Institute	Vizhinijam	October 17-20, 2000
Dr. M. Vijayakumaran, Dr. P. Jayasankar and Dr. Manpal Sridhar	Fifth Indian Fisheries Forum	Asian Fisheries Society, Indian branch	Central Institute of Freshwater Aquaculture, Bhubaneswar	January 17-20, 2000
Dr. K.S. Sobhana and Shri A.P. Dineshbabu	Summer School on Recent Advances in Marine Biotechnology	Central Institute of Fisheries Education	Mumbai	August 7-27, 2000
Dr. V. Kripa and Dr. Manpal Sridhar	National Seminar on Official Language on Pollution of Aquatic Environment and its Impact on Fishery Resources	Central Institute of Fisheries Technology	Cochin	September 6-7, 2000

Dr. V.V. Singh, Shri S.G. Raje, Smt. P.T. Sarada, Smt. Geetha Sasikumar and Ms. Laxmi Pillai	Training Programme on Computer Applications in Fisheries	Central Institute of Fisheries Education	Mumbai	November 16 to December 6, 200
Dr. P.C. Thomas, Dr. P. Laxmilatha and Dr. Shoji Joseph	Hindi Workshop	Central Marine Fisheries Research Institute	Cochin	December 19-20, 2000
Dr. V.D. Deshmukh, Sshri M.Z. Khan and Dr. V.V. Singh	Workshop on Overcapacity vis a vis Fishery Resources in the Sea		Arnala	July 21-22, 2000
Dr. V.D. Deshmukh, Shri S.G. Raje and Dr. V.V. Singh	National Conference on Fisheries Economics, Extension and Management	Central Institute of Fisheries Education	Mumbai	January 5, 2000
Dr. C. Muthiah and Shri A.P. Dineshbabu	Workshop on Satellite Based Potential Fishery Zone Predictions	INCOIS and Karnataka State Remote Sensing Application Centre	Mangalaore	November 27, 2000
Dr. G. Nandakumar, Dr. K.N. Rajan, Dr. L. Krishnan, Mrs. Sheela Immanuel, Dr. S. Ashaletha and Dr. C. Ramachandran	10th Swadeshi Science Congress	Swadeshi Science Movement	Cochin	November 7-9, 2000
Dr. S. Ashaletha and Dr. C. Ramachandran	One day Workshop on Problems and Prospects of prawn peeling in Kerala	All Kerala Prawn Peeling Owner's Association	Eramalloor	July 7, 2000
Dr. A.K.V. Nasser and Dr. S.R. Krupesha Sharma	National Seminar on Problems Confronting		Kodungallur	October 14, 2000

	Prawn Farmers in Kerala			
Dr.G. Syda Rao and U. Rajkumar	National Workshop on Trends in Ocean Sciences 21st century (TOS -2K+)	National Institute of Oceanography, Regional Centre	Visakha-patnam	September 25-26, 2000
Dr. E.V. Radhakrishnan and Dr. P. Nammalwar,	National Seminar and Exhibition on Sustainable Fisheries and Aquaculture for Nutritional Security	National Academy of Agricultural Sciences, ICAR, Madurai Kamaraj University and Aquaculture Foundation of India	Chennai	November 29 to December 2, 2000
Shri K.K. Philipose and Shri P.K. Asokan	Project Committee Meeting on Kannur Ocean Park	Kannur Collectorate	Kannur	July 13, 2000
Dr. R. Sarvesan and Dr. P. Nammalwar	Expert Group Meeting of the Coastal and Marine Ecosystems of the National Bioresources Development Board sponsored by Department of Biotechnology	M.S.Swaminathan Research Foundation,	Chennai	November 27, 2000



Trainee from Bahrain implanting nucleus in Pearl oyster at the Shellfish Laboratory of the Institute at Tuticorin.

Dr.E.G.Silas, Former Director, CMFRI, delivering the address during the brain storming session at Cochin

Meeting of the Research Advisory Committee of CMFRI at Cochin

Sri Hukum Deo Narayan Yadav, the Honourable Union Minister of State for Agriculture, Govt. of India, felicitated by Dr. V.N. Pillai, Director during his visit to CMFRI

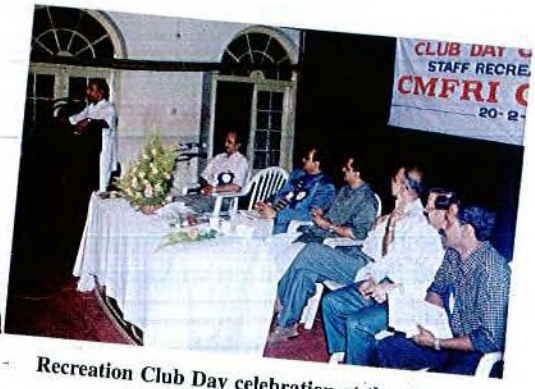
New mobile van of the Institute

Prof. (Dr) Mohan Joseph Modayil, Director, CMFRI delivering the welcome address at National Workshop on Scombroids, at CMFRI, Cochin

WORKSHOPS, SYMPOSIA, SEMINARS ETC. ORGANISED

1. A workshop on mussel farming was organised at Mangalore Research Centre of CMFRI on 20th January 2000 to popularise mussel culture and create awareness about the technology available with the Institute.
2. A Marine Aquarium Show was arranged at Kanakakunnu Palace, Trivandrum during January 2000 in connection with Flower Show 2000 and the CMFRI, Vizhinjam Centre won the prize for best marine aquarium.
3. An Open House was held at the Karapad Complex of Tuticorin Research Centre of CMFRI from 8-10 March 2000 wherein various mariculture technologies developed, ornamental fishes and activities of the Centre were displayed and demonstrated to the Public.
4. A National Symposium on " Eco-friendly Mariculture Technology Packages – an Up-date" was organized during 25-26th April,2000 at the Mandapam Regional Centre of CMFRI in collaboration with the Marine Biological Association of India.
5. A Hindi workshop was organised at Minicoy Research Centre on 6-6-2000
6. A National Consultative Planning Workshop of the Project ADB-RETA 5766 Sustainable Management of Coastal Fish Stocks in Asia was jointly organised by ICLARM/CMFRI at CMFRI, Cochin during 1-3 August, 2000.
7. Organised and conducted a National Workshop on Scombroids at CMFRI, Cochin during 19-20 September, 2000.
8. Field Experience Training (FET) was conducted for 6 ARS Scientists of 71st FOCARS deputed by NAARM, Hyderabad at Mandapam Regional Centre of CMFRI for a period of one month from 9.10.2000 to 8.11.2000.
9. Training on pearl oyster seed production, farming and pearl production was conducted at Tuticorin Research Centre of CMFRI from 16.11.2000 to 30.12.2000. Four candidates from Bahrain Society for Pearls and Oysters, sponsored by Government of Bahrain through Govt. of India were given the training.

Women Cell of the CMFRI, being inaugurated by Prof.(Dr) K.S. Kumari, Head of the Dept. of Home Science, St. Theresas College, Ernakulam



Recreation Club Day celebration at the Calicut Research Centre of CMFRI

Inauguration of "Charity Fund" of the Institute by Prof. M.K. Sanu

Participants of the training on FEEL Research Administrator conducted by CLHRD, Mangalore at Cochin

Shri Kalapeedam Kaladharan inaugurating the CMFRI Recreation Club

DISTINGUISHED VISITORS

Cochin

Shri S. Amarasekara, Secretary, Ministry of Fisheries and Aquatic Resources Development, Colombo

3 member delegation from National Institute of Agricultural Research (INRA), Moracow.

Shri Hukumdeo Narayan Yadav, Hon'ble Minister of State for Agriculture, Govt. of India

Quinquennial Review Team compromising Dr. S.D. Tripathi (Former Director, CIFE, Mumbai) as Chairman, Dr. D. Sudarsan (Former DG, FSI) and Dr. K. Muralidhar (Prof. & Head of Department of Zoology, University of Delhi), Dr. N.C. Ganguli (former ADG, ICA) and Dr. M.N. Kutty (formerly of FAO/NACA) as members.

Shri Babubhai Bokharia, Hon'ble Minister of Fisheries, Gujarat State and Shri N.A. Vhora, IAS, Commissioner of Fisheries, Gujarat

Prof. N. Balakrishnan Nair, Ex. Chairman, State Committee on Science, Technology & Environment & Secretary to the Govt. of Kerala

Dr. K. Radhakrishna, Retd. ADG (M.Fy), ICAR, New Delhi

Dr. M. Umamaheswara Rao, Professor of Botany (Retd), Andhra University, Waltair

Tuticorin

Sri N.V.Madhavan, IAS, Principal Secretary, Fisheries, Government of Kerala, Trivandrum

Shri R.Prabhakaran, Director of Fisheries,Government of Kerala, Trivandrum

Shri K.K.Ravindran, Chief Engineer, Harbour Engineering Department, Trivandrum

Shri W.S.A. Kanthiah, General Manager, Heavy Water Plant, Tuticorin

Shri V.Jeyaraman, Executive Director, SPIC, Tuticorin

Shri R.Henry, Municipal Chairman, Tuticorin Municipality, Tuticorin

Shri Bharathi Raaja, Film Director, Chennai

Dr. A.G.Ponniah, Director, NBFGR, Lucknow

Shri Ansar Ali, Director of Fisheries, Government of Tamil nadu, Chennai

Dr.K.S.K.Velmani, Editor Gazaetteer, Chennai

Mrs. Vasanthi, Editor, India Today, (Tamil), Chennai

Shri R.Jayakumar and his team, Geological Survey of India, Mangalore

Shri S. Harold Wright, Patricia D.Durfey, JanathanL.Roberts, U.S.A.

Dr. S.D.Tripathi, Director (Retd.) CIFE, and Chairman, QRT accompanied by Dr. V.Sriramachandra Murty Member Secretary, QRT

The Station Director, All India Radio, Tuticorin (Special broadcast to Sri Lanka)

Minicoy

Dr. P.T. Mathew and Dr. P.K. Surendran, Scientists, CIFT, Kochi

Smt. Girija, Technical Officer, KVK, Vellanad, Trivandrum

Dr. Rajan, Dr. Dhanapal and Dr. Arunachalam, Scientists, CPCRI, Kasaragod

Veraval

Dr. Rishad Parvez, Sr. Scientist, Dept. of Zoology, School of Science, Gujarat University, Ahmedabad

The Manager, Khatri Sea Foods, Veraval

Shri Barabat Babubhai Oza, Sutrapada

Dr. K. Devadasan, Director, CIFT, Cochin

Dr.R.S. Paroda, Director General, ICAR., received by scientists of CMFRI and CIFT at the Cochin International Airport

Delegates from DFID, UK visit the Institute

Shri R.S. Prasad, Joint Secretary (DARE) and Financial Advisor (ICAR) with the Director, CMFRI

Dr. B.N. Singh, ADG (Inland Fisheries) at the CMFRI Museum at Headquarters

Shri Babu Bhai Bokhiriya, Hon'ble Minister for Fisheries, Gujarat, being received by Dr.A.D. Diwan, ADG (MFy.) ICAR at CMFRI Cochin

Dr. P.U. Verghese, Retd. Director, MPEDA, Cochin

Dr. Y. Sreekrishna, Principal Scientist, CIFE, Mumbai

Shri V. Anbalagan, CIFE, Mumbai

Shri N.A. Vhora, Commissioner of Fisheries, Gandhinagar

Shri Sharad Shah, Gujarat Industrial & Technical Consultancy Organisation Ltd., Ahmedabad

Prof. N. Krishnamurthy, Bhavanagar

Shri A.W.. Banatwala, Managing Director, Hotel Park, Veraval

Shri S.X. Prince, Deputy Ddirector, MPEDA, Valsad

Shri Vrajlal Narandas, Press Reporter, Gujarat Samachar, Veraval

Dr. Alexander Thomas, Deputy Director, MPEDA, Cochin

Dr. U.V. Jadhav, Chief Manager, State Bank of Saurashtra, Bhavanagar

Kakinada

Dr. Vija Dev Singh, former Joint Commissioner of Fisheries, Govt. of India, New Delhi

Prof. K. Muralidhar, Department of Zoology, University of Delhi, Member, QRT

Prof. D. Sudarsan, Former Director General, Fishery Survey of India, Visakhapatnam, Member, QRT

Dr. S. Ayyappan, Director, CIFE, Mumbai

Shri M.R.Dandekar, Manager, NABARD, Hyderabad

Mangalore

Shri D.S. Bhat, AGM, NABARD, Mangalore

Dr. Z.A. Ansari, Asst. Director, NIO, Goa

Dr. P. Rethinam, AED Coastal Ecosystem, NATP & Director NRC Oilpalm, Pedavegi, Andhra Pradesh

Vizhinjam

LT Gen. Surinder Nath, Chairman, UPSC, New Delhi

Dr. S.N. Behu, Director of Horticulture, Orissa

Dr. K.V. Devaraj, Former Vice Chancellor, UAS, Bangalore

Chairman and Members of QRT, Dr. S.D. Tripathi,Dr. N.C. Ganguli, Dr. K. Muralidhar and Dr. D. Sudarsan

Dr. M.A. Kuttappan, MLA, Kerala

Dr. R.C. Upadhyaya, Director, NRC for Orchids, Pakyong

Shri J.N. Tiwari, Cabinet Minister, Export promotion, Public enterprises, Relief and Rehabilitation, Government of U. P.

Shri Babubhai Bokharia, Honorable Minister of Fisheries, Government of Gujarat

Shri D.V. Mahesh, IPS, Director of Postal Services, New Delhi.

Mandapam

Dr.A.Padmanabhan, Development Commissioner, Government of Pondicherry, Pondicherry.

Shri N.V.Madhavan, Principal Secretary, Department of Fisheries, Kerala, Trivandrum.

Shri R.Prabhakaran, Director of Fisheries, Kerala

Shri K.K.Raveendran, Chief Engineer, Harbour Engineering Department, Trivandrum

Dr.K.Gopakumar, Deputy Director General (Fy.), ICAR, Krishi Bhavan, New Delhi.

Dr.P.S.B.R.James, Former Director, CMFRI

Dr.M.Devaraj, Former Director, CMFRI

Dr.T.J.Pandian, National Professor, Department of Biotechnology, Madurai Kamaraj University, Madurai

Shri P. Selvaraj, Deputy Director of Agriculture (Seeds), Ramanathapuram

Dr.D.N.Gautham, I.P.S., IGP S/Sector, CRP, Hyderabad

Comdt.B.R.Kamath, Comdt.77.B.W.CRPT,

Dr.S.L.Mehta, D.D.G (Education), ICAR, New Delhi

Shri T.K.Ramachandran, I.A.S., District Collector, Ramanathapuram

Dr. S..D. Tripathi, Chairman QRT

Visakhapatnam

Shri J.V.H. Dixitulu, Editor, Fishing Chimes

Dr. K. Muralidhar and Dr. D. Sudarsan, Members of QRT

Dr. P. Natarajan, Professor and Head, Dept. of Aquatic Biology and Fisheries, University of Kerala, Trivandrum

Dr. M. Sakthivel, Principal, Kamaraj College, Tuticorin, Tamil Nadu

Dr. A. Ram, Head, Dept. of Zoology, R.A. College, Wasim, Amaravati University, Maharashtra

Dr. A. Malu, Professor, Dept. of Zoology, R.A. College, Wasim, Amaravati University, Maharashtra

Dr. I.K. Chatterji, Head, Dept. of Zoology, Bankura Christian College, West Bengal

Calicut

Mrs. Sunanda Mane Programmes representative CARE INDIA, Mumbai along with trainees

Mrs. Pulkita Sood, Acquisition Officer, United States Library of Congress

Smt. I Indira Krishna Kumar, Post Master General, Kozhikode

Jean Paul Peter Schmitt, Trade Commissioner, French Trade Mission Bangalore

Chrishtophe Liacopoulos, Development Manager, Nausicaa, Mercedes, France

Shri K. Abdul Latheef, Science Reporter, New Indian Express,Kozhikode

Shri K. Thankappan, IAS, Director of Fisheries, Govt. of Kerala , Trivandrum

Dr. Usha Titus, IAS, District Collector, Kozhikode

Shri Thottathil Ravindran, Mayer, Kozhikode Corporation

Shri Babu Parassery, Block Panchayath Vice President, Kozhikode

Shri M.K. Berly, Project Officer, DRDA, Kozhikode

Shri Ananda Narayana Ayer, Regional Manager, NABARD, Kozhikode

Shri K. Vijayakumar, Assistant Director, MPEDA, Kochi

Shri Sabu MC, Consultant, MATSYAFED, Trivandrum

Prof. N. Sivarajan, Aiswarya Ornamental Fish Farm, Alathur, Palakkad

Shri T. Siddarthan, Joint Director of Fisheries, North Zone, Kozhikode

Shri J.I. Joseph, Deputy Director of Fisheries, Kozhikode.

Karwar

Shri M.A. Upare, General Manager, National Bank for Agricultural and Rural Development, Mumbai

Shri H.N. Chandrashekharaiah, Retired Joint Director of Fisheries, Govt. of Karnataka, Bangalore

Shri I.S.M. Achar, Director, Institute for Environmental Management, Central College Campus, Bangalore

Prof. Bhosele, S.H. Shankarrao Miohitae Mahavidyalaya, Maharashtra

Mumbai

Dr. A.N. Syed and Dr. Manisha Kavari, Food Technology Division of Bhabha Atomic Research Centre

Prof. Jayapaul Singh , University of Central Lankashire

Shri K.L. Grover, S.O., ICAR, New Delhi

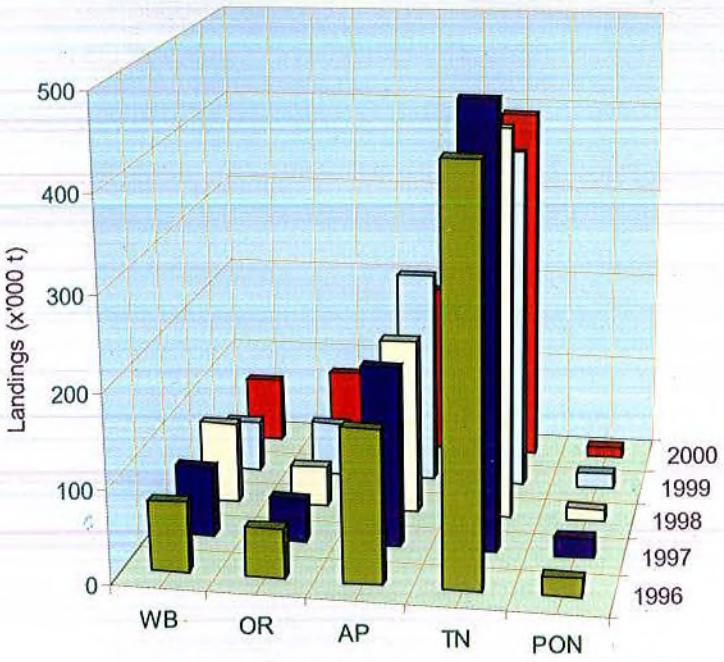
Dr. S.D. Tripathi, Chairman, QRT

Vizhinjam	-	Dr. P.P. Pillai Principal Scientist
Mumbai	-	Dr. V.D. Deshmukh Sr. Scientist
Minicoy	-	Shri M. Sivadas Scientist (Sr. Scale)
Visakhapatnam	-	Dr. G. Syda Rao Sr. Scientist
Calicut	-	Dr. T.M. Yohannan Sr. Scientist
Krishi Vigyan Kendra	-	Shri K.P. Said Koya Scientist (Sr. Scale)
Trainers' Training Centre	-	Dr. A. Laxminarayana Chief Training Officer
Fisheries Harbour Laboratory	-	Shri P.E. Sampson Manickam Sr. Scientist
Field Mariculture Centre	-	Shri K.V. Somasekharan Nair Sr. Scientist

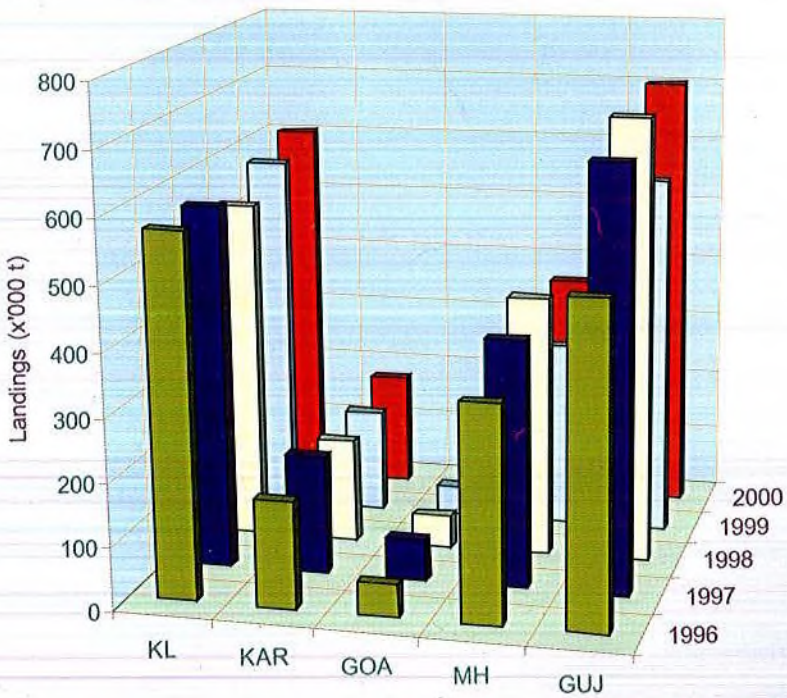
SPECIAL INFRASTRUCTURAL DEVELOPMENT

The research laboratories of the Institute at Headquarters and Research Centers were upgraded by installing new equipments like Kjelplus Automatic Nitrogen Protein estimation system, Electrophoretic units, Ultra temperature freezer and spectrophotometers. For detailed anatomic and biological studies microscope with zoom and computer facilities were also installed.

As a part of office automation, computers and reprographic equipments were purchased. Two new vehicles (*Swaraj Mazda and Mahindra Jeep*) were purchased.



Marine fish landings along the coasts of east coast states during 1996 - 2000



Marine fish landings along the coasts of west coast states during 1996 - 2000